Final

# Treatability Study to Evaluate Remediation by Natural Attenuation at UST Sites 10-494, 10-495, And 10-496

VOLUME 1 OF 1: TEXT AND APPENDICES

**BEALE AIR FORCE BASE**
**CALIFORNIA**

*Prepared for*

**Air Force Center For Environmental Excellence**
**Technology Transfer Division**
**Brooks Air Force Base**
**San Antonio, Texas**

*and*

**9 CES/CEVR**
**Beale Air Force Base, California**

March 1999



*Prepared by*

PARSONS ENGINEERING SCIENCE, INC.
*2101 WEBSTER STREET, SUITE 700, OAKLAND, CA 94612 • 510/891-9085*
*1700 BROADWAY - SUITE 900, DENVER, CO 80290 • 303/831-8100*
*OFFICES IN OTHER PRINCIPAL CITIES*
*722450/14*

**Walton, Norman**

**From:** Hansen, Jerry E, Mr, HQAFCEE [Jerry.Hansen@HQAFCEE.brooks.af.mil]
**Sent:** Tuesday, August 08, 2000 10:16 AM
**To:** 'nwalton@dtic.mil'
**Subject:** Distribution statement for AFCEE/ERT reports

Norman, This is a followup to our phone call. The eight boxes of reports you received from us are all for unlimited distribution. If you have any questions, you can contact me at DSN 240-4353.

*FINAL*

# TREATABILITY STUDY TO EVALUATE REMEDIATION BY NATURAL ATTENUATION AT UST SITES 10-494, 10-495, AND 10-496

***at***

# BEALE AIR FORCE BASE, CALIFORNIA

***Prepared for***

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| 2-D | two-dimensional |
| ADIP | alternating-direction implicit procedure |
| AFB | Air Force Base |
| AFCEE | Air Force Center For Environmental Excellence |
| ASCII | American Standard Code for Information Interchange |
| atm-$m^3$/mol | atmosphere-cubic meters per mole |
| bgs | below ground surface |
| BOD | biological oxygen demand |
| BTEX | benzene, toluene, ethylbenzene, and total xylenes |
| °C | degrees centigrade (Celsius) |
| $CaCO_3$ | calcium carbonate |
| cfs | cubic feet per second |
| cm/s | centimeter per second |
| DO | dissolved oxygen |
| EAL | Evergreen Analytical Laboratory, Inc. |
| EC | electrical conductivity |
| ET | evapotranspiration |
| °F | degrees Fahrenheit |
| $Fe^{+2}$ | ferrous iron |
| ft | foot/feet |
| $ft^2$ | square feet |
| ft/s | feet per second |
| g/$cm^3$ | grams per cubic centimeter |
| HDPE | high-density polyethylene |
| Hg | mercury |
| ID | inside diameter |
| IDW | investigation-derived waste |
| $K_{oc}$ | soil sorption coefficient |
| kg | kilogram |
| L | liter |
| LAW | Law Environmental, Inc. |
| LLNL | Lawrence Livermore National Laboratory |
| LNAPL | light nonaqueous-phase liquid |
| LTM | long-term monitoring |
| MCL | Maximum Contaminant Level |
| µg | micrograms |
| mg | milligrams |
| MOC | Method of Characteristics |
| MP | monitoring point |
| msl | mean sea level |
| mV | millivolts |

## LIST OF ABBREVIATIONS (continued)

| | |
|---|---|
| MW | monitoring well |
| N | nitrogen |
| NRMRL | National Risk Management Research Laboratory |
| OD | outside diameter |
| ORD | Office of Research and Development |
| OSWER | Office of Solid Waste and Emergency Response |
| Parsons ES | Parsons Engineering Science, Inc. |
| PEI | Phillippi Engineering, Inc. |
| pH | negative logarithm of the hydrogen ion concentration |
| POC | point-of-compliance |
| ppmv | parts per million, by volume |
| PVC | polyvinyl chloride |
| QC | quality control |
| $r^2$ | coefficient of determination |
| R | retardation coefficient |
| RAOs | remedial action objectives |
| redox | reduction/oxidation potential |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| RMS | root mean square |
| RNA | remediation by natural attenuation |
| RWQCB | Regional Water Quality Control Board (California) |
| s | second |
| SAP | sampling and analysis plan |
| SB | soil boring |
| SVP | soil vapor point |
| SW | surface water |
| SWRCB | State Water Resources Control Board (California) |
| TEMB | tetramethylbenzene |
| TMB | trimethylbenzene |
| TOC | total organic carbon |
| TPH | total petroleum hydrocarbons |
| TPH d | TPH as diesel fuel |
| TPH-g | TPH as gasoline |
| TS | treatability study |
| TVH | total volatile hydrocarbons |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |
| UST | underground storage tank |
| VOCs | volatile organic compounds |

# EXECUTIVE SUMMARY

This report presents the results of a treatability study performed by Parsons Engineering Science, Inc. (Parsons ES) at UST Sites 10-494, 10-495, and 10-496 (UST Site), Beale Air Force Base, California to evaluate the use of remediation by natural attenuation (RNA) with long-term monitoring (LTM) as a remedial option for dissolved benzene, toluene, ethylbenzene, and xylene (BTEX) and total petroleum hydrocarbons as gasoline (TPH-g) contamination in the shallow groundwater. This study focused on the impact of dissolved BTEX and TPH-g compounds on the shallow groundwater system at the site. Site history and the results of soil and groundwater investigations conducted previously are also summarized in this report.

Comparison of BTEX, TPH-g, electron acceptor, and biodegradation byproduct isopleth maps for the UST Site provides strong qualitative evidence of biodegradation of BTEX and TPH-g compounds. Geochemical data strongly suggest that biodegradation of fuel hydrocarbons is occurring at the site via the anaerobic processes of denitrification and iron reduction. Aerobic biodegradation also is likely to occur in the near future due to recent changes in site conditions.

An important component of this study was an assessment of the potential for contamination in groundwater to migrate from the source areas to potential receptors. In particular, this component focused on the contaminant mass loading resulting from the discharge of contaminated groundwater into the surface water drainage channel southeast of the site. To help estimate mass loading rates into the drainage channel and make predictions for future contaminant reductions in groundwater, the Bioplume II model was used to estimate the rate and direction of dissolved BTEX movement through the shallow saturated zone under the influence of advection, dispersion, sorption, and biodegradation. Input parameters for the Bioplume II model were obtained from existing site characterization data, supplemented with data collected by Parsons ES. Extensive site-specific data were used for model implementation. Model parameters that were not measured at the site were estimated using reasonable literature values.

The results of this demonstration suggest that RNA of BTEX and TPH-g compounds is occurring at the UST Site, and that dissolved contamination present in groundwater poses no significant risk to human health or the environment in its present, or predicted future, concentrations and distribution. Model results indicate that eventually the contaminant plume will disappear and that restrictions on groundwater use could be removed in the future. Although discharges of BTEX and TPH-g to surface water have likely occurred in the past, the concentrations of BTEX and TPH-g in groundwater currently discharging to the drainage channel do not appear to be resulting in any detectable contamination in surface water, as confirmed by analysis of surface water samples collected during this study.

The Air Force recommends that RNA, LTM, and institutional controls be implemented at the site. Bioplume II modeling results suggest that such an approach could result in reduced maximum contaminant concentrations in the source area and reduced concentrations downgradient from the existing plume over time. Institutional controls, such as proper management and disposal of any extracted groundwater and requirements for implementation of adequate health and safety plans for site workers, would protect human health and the environment while remediation is occurring and could be removed in the future once groundwater contaminant concentrations reach water quality objectives.

To verify the Bioplume II model predictions, the Air Force recommends using three LTM wells and three surface water locations to close existing data gaps in the site characterization and monitor the long-term migration and attenuation of the contaminant plume. The presence of free product/mobile LNAPL should be evaluated during installation of the new LTM well in the source area and removed to the extent practicable in compliance with regulatory requirements. One of the new LTM wells should be installed on the eastern side of the drainage channel to confirm that the groundwater contaminants have not migrated beneath the drainage channel. Because of the removal of the compost pile near the source area at this site, the groundwater geochemistry can be expected to change within the next few years. Therefore, it is recommended that the assimilative capacity of site groundwater be reevaluated during LTM.

Groundwater and surface water samples and elevation measurements should be collected quarterly for at least one year to determine seasonal variations in groundwater flow direction and gradient and contaminant concentrations at the site. Thereafter, it is expected that sampling frequency could be reduced to annually. The LTM plan presented in this report will serve as an interim LTM until installation of the LTM wells and completion of the first year of sampling (4 quarterly sampling rounds). Regular sampling and analysis of groundwater and surface water from LTM wells and surface water locations will allow the effectiveness of RNA to be monitored and should allow sufficient time to implement additional engineering controls to contain the plume if BTEX or TPH-g compounds are detected above levels of concern in the surface water or increase significantly in the groundwater.

Contaminant fate and transport model results indicate that LTM wells and surface water locations should be sampled for 15 years, after which time it is expected that the plume will disappear. Both groundwater samples and surface water samples should be analyzed for BTEX compounds by US Environmental Protection Agency (USEPA) Method SW8021 and TPH-g by USEPA Method 8015B. Groundwater samples should also be analyzed for dissolved oxygen and additional geochemical parameters to verify the progress of RNA. If any BTEX or TPH-g concentrations detected in surface water exceed the water quality objectives or concentrations in groundwater are increasing significantly greater than that predicted by modeling results, additional corrective actions and comparative cost analyses may be required to remediate groundwater at the site.

# SECTION 1

# INTRODUCTION

This report was prepared by Parsons Engineering Science, Inc. (Parsons ES) and presents the results of a treatability study (TS) conducted to evaluate the use of remediation by natural attenuation (RNA) for remediation of groundwater contaminated by petroleum hydrocarbons at UST Sites 10-494, 10-495, and 10-496 (UST Site), Beale Air Force Base (AFB), California. Previous investigations have shown that soils and groundwater at this site are contaminated with gasoline.

As used throughout this report, RNA refers to a management strategy that relies on natural attenuation mechanisms to remediate contaminants dissolved in groundwater, to control receptor exposure risks associated with contaminants in the subsurface, and to meet water quality objectives. The United States Environmental Protection Agency (USEPA) Office of Research and Development (ORD) and Office of Solid Waste and Emergency Response (OSWER) define natural attenuation as:

> *The biodegradation, dispersion, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility, or volume to levels that are protective of human health and the ecosystem.*

As suggested by this definition, mechanisms for natural attenuation of BTEX include advection, dispersion, dilution from recharge, sorption, volatilization, and biodegradation. Of these processes, biodegradation is the only mechanism working to transform contaminants into innocuous byproducts. Contaminant destruction occurs through biodegradation when indigenous microorganisms work to bring about a reduction in the total mass of contamination in the subsurface without the addition of nutrients. Patterns and rates of natural attenuation can vary markedly from site to site depending on governing physical and chemical processes.

The main emphasis of the work described herein was to evaluate the potential for naturally occurring degradation mechanisms to reduce dissolved BTEX concentrations in groundwater to levels that are protective of human health and the environment.

## 1.1 SCOPE AND OBJECTIVES

Parsons ES, in conjunction with researchers from the United States Environmental Protection Agency (USEPA) National Risk Management Research Laboratory (NRMRL) Subsurface Protection and Remediation Division, was retained by the United States Air Force Center for Environmental Excellence (AFCEE) Technology Transfer Division to conduct site

characterization and groundwater modeling to evaluate the scientific defensibility of RNA with long-term monitoring (LTM) as a remedial option for gasoline-contaminated groundwater at the UST Site at Beale AFB. Performance of numerous tasks was required in order to fulfill the project objective. These tasks included:

- Reviewing existing hydrogeologic and soil and groundwater quality data for the site;
- Conducting supplemental site characterization activities to determine the nature and extent of soil, groundwater, and surface water contamination;
- Collecting geochemical data in support of RNA;
- Developing a conceptual hydrogeologic model of the shallow saturated zone, including the current distribution of contaminants;
- Evaluating site-specific data to determine whether naturally occurring processes of contaminant attenuation and destruction are occurring in groundwater at the site;
- Designing and executing a Bioplume II model for site hydrogeologic conditions;
- Simulating the fate and transport of fuel hydrocarbons in groundwater under the influence of advection, dispersion, adsorption, and biodegradation using the Bioplume II model;
- Evaluating a range of model input parameters to determine the sensitivity of the model to those parameters and to consider, if necessary, several contaminant fate and transport scenarios;
- Determining if naturally occurring processes are sufficient to minimize BTEX plume expansion so that groundwater and surface water quality objectives can be met at a downgradient point of compliance (POC);
- Conducting a preliminary exposure pathways analysis for potential current and future receptors;
- Developing remedial action objectives (RAOs) and reviewing available remedial technologies;
- Using the results of modeling to recommend the most appropriate remedial option based on specific effectiveness, implementability, and cost criteria; and
- Providing an LTM plan that includes LTM and POC locations and a sampling and analysis plan (SAP).

Site characterization activities in support of RNA conducted for this report included soil sampling for lithological characterization; installation of groundwater monitoring points; static groundwater level measurement at existing monitoring wells and newly installed monitoring points; groundwater sample collection and analysis from existing site monitoring wells and newly installed monitoring points; and surface water sample collection and

analysis from two drainage ditches downgradient from the site. Previous site investigation activities and results were used to guide placement of sampling locations for this study.

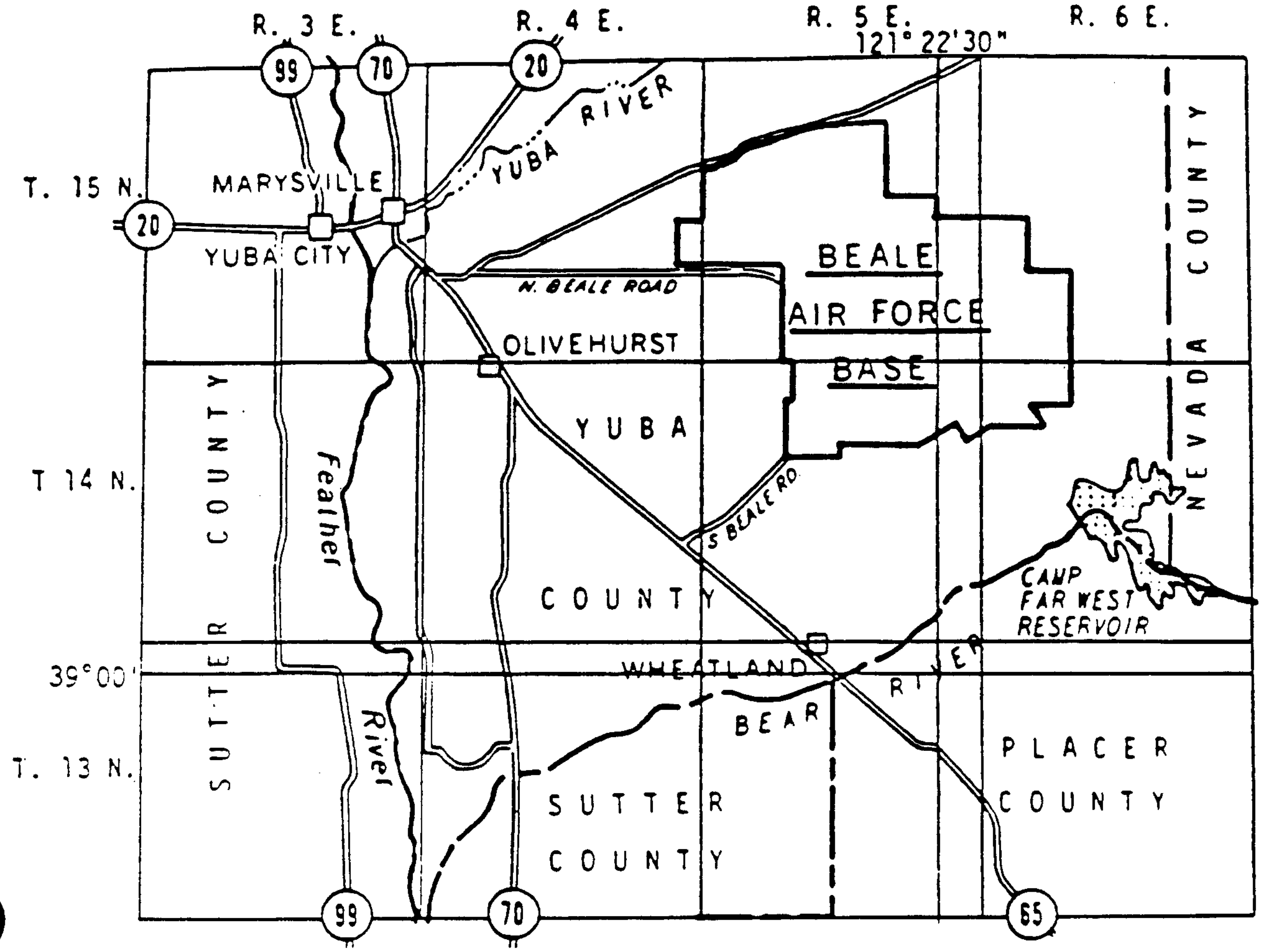
Site-specific data were used to develop groundwater flow and solute fate and transport models for the site using Bioplume II, and to conduct a preliminary receptor exposure pathways analysis. The modeling effort was used to predict the future extent and concentrations of the dissolved contaminant plume by modeling the combined effects of advection, dispersion, sorption, and biodegradation on dissolved BTEX. Results of the model were used to assess the potential for completion of exposure pathways involving groundwater and to determine whether RNA with LTM and institutional controls is an appropriate and defensible remedial option for contaminated groundwater. The results will be used to provide technical support for the RNA with LTM and institutional controls remedial option during regulatory negotiations, as appropriate.

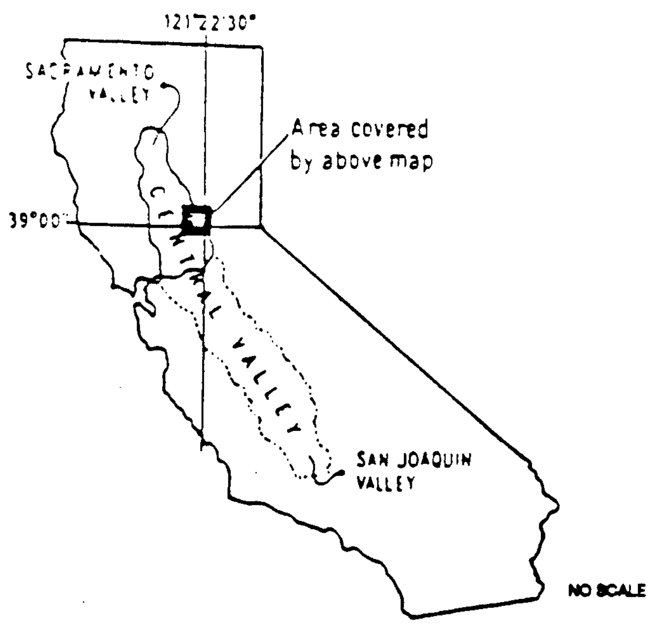
Alternate remedial options were considered to identify the major advantages and disadvantages associated with different groundwater remedial strategies. These options included groundwater extraction/containment via vertical wells and/or interceptor trenches (pump and treat); air sparging; physical containment using slurry walls, grout curtains, or sheet piles; and funnel and reactive gate walls. Hydrogeologic and groundwater chemical data necessary to evaluate these remedial options were either collected under this program or were available from previous investigations of this site or from the technical literature. Field work conducted under this program, however, was oriented toward the collection of hydrogeologic data to be used as input into the Bioplume II groundwater model in support of RNA with LTM for restoration of fuel-hydrocarbon-contaminated groundwater.

This TS contains nine sections, including this introduction, and six appendices. Section 2 summarizes site characterization activities. Section 3 summarizes the physical characteristics of the study area. Section 4 describes the nature and extent of soil, groundwater, and surface water contamination and the geochemistry of groundwater at the site. Section 5 describes the Bioplume II model and design of the conceptual model for the site; lists model assumptions and input parameters; and describes sensitivity analysis, model output, and the results of the Bioplume II modeling. Section 6 presents a comparative analysis of remedial alternatives. Section 7 presents the LTM plan for the site. Section 8 presents the conclusions of this work and provides recommendations for further work at the site. Section 9 lists the references used to develop this document. Appendix A contains borehole logs and monitoring point construction diagrams. Appendix B contains analytical results from previous site investigations. Appendix C presents soil, groundwater, and surface water analytical results from this study. Appendix D contains model input parameters and calculations related to model calibration. Appendix E contains Bioplume II model input and output in American Standard Code for Information Interchange (ASCII) format on a diskette. Appendix F contains calculations for remedial option design and costing.

## 1.2 FACILITY BACKGROUND

Beale AFB is located in Yuba County, California, approximately 50 miles north of Sacramento and 10 miles east of the city of Marysville (Figure 1.1). The Base occupies approximately 23,000 acres of land in Yuba County and has 8,000 military and non-military




0 2 4
APPROX. SCALE IN MILES

SOURCE: GROUNDWATER CONDITIONS AT BEALE AIR FORCE BASE AND VICINITY, CALIFORNIA. U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 80-204. PAGE 1980

FIGURE 1.1

**VICINITY MAP**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

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**Alameda, California**

\722450\14\GRAPHICS\FIGS_P8.CDR 10/28/96

personnel on site on a daily basis. The land surrounding the Base is primarily used for agriculture.

The project site is located in the central portion of the Base (Figure 1.2) near the intersection of 30th and A Streets (Figure 1.3). Three 12,000-gallon USTs (which have been designated USTs 10-494, 10-495, and 10-496) were installed at the site in the early 1940s. The USTs were placed on concrete saddles set 6 feet below ground surface (bgs). The tanks were used primarily for gasoline storage and were part of a series of six armored tank division fueling stations located along A Street. All three tanks are reported to have been removed prior to 1962; however, the preformed concrete saddles were left in place. The fuel pipelines that supplied the USTs are inactive but still in place. Law Environmental, Inc. (LAW) and Metcalf & Eddy conducted investigations of the pipeline, which runs throughout the Base, in 1994 (LAW, 1995).

The excavation pit, which was left open after tank removal activities, was used as a compost pile for landscape waste until November 1995. In November 1995, the compost pile was removed. the excavation pit was filled with clean soil, and the site was completely regraded. There are no buildings in the immediate vicinity of the site, and the land surrounding the site is not currently in use. The site is surrounded on three sides by surface water drainage ditches; however, only the largest drainage channel east of the site contains water year-round.

In December 1994, LAW (1995) conducted a preliminary site investigation that included advancement of seven soil vapor points to depths ranging from 5.5 to 8.5 feet bgs. In February 1995, Metcalf & Eddy advanced seven soil borings around the site to depths ranging from 6 to 18 feet bgs. Two of these soil boreholes, SB-1 and SB-2, were converted to monitoring wells, designated MW-1 and MW-2. In addition, a total of seven test pits were excavated to depths between 6 and 9 feet bgs.

Groundwater was encountered in soil boreholes and test pits at depths of 3 to 6 feet bgs. During the drilling of boreholes and vapor points in the immediate vicinity of the tank pit area, a visual inspection of groundwater indicated the presence of mobile light nonaqueous-phase liquid (LNAPL), or free product. The full extent of contamination, the source of contamination, and the groundwater flow direction and gradient were not determined during prior investigations. Analytical results from soil, groundwater, and soil vapor sampling conducted during the prior investigations are discussed in Section 4 and detailed in Appendix B.

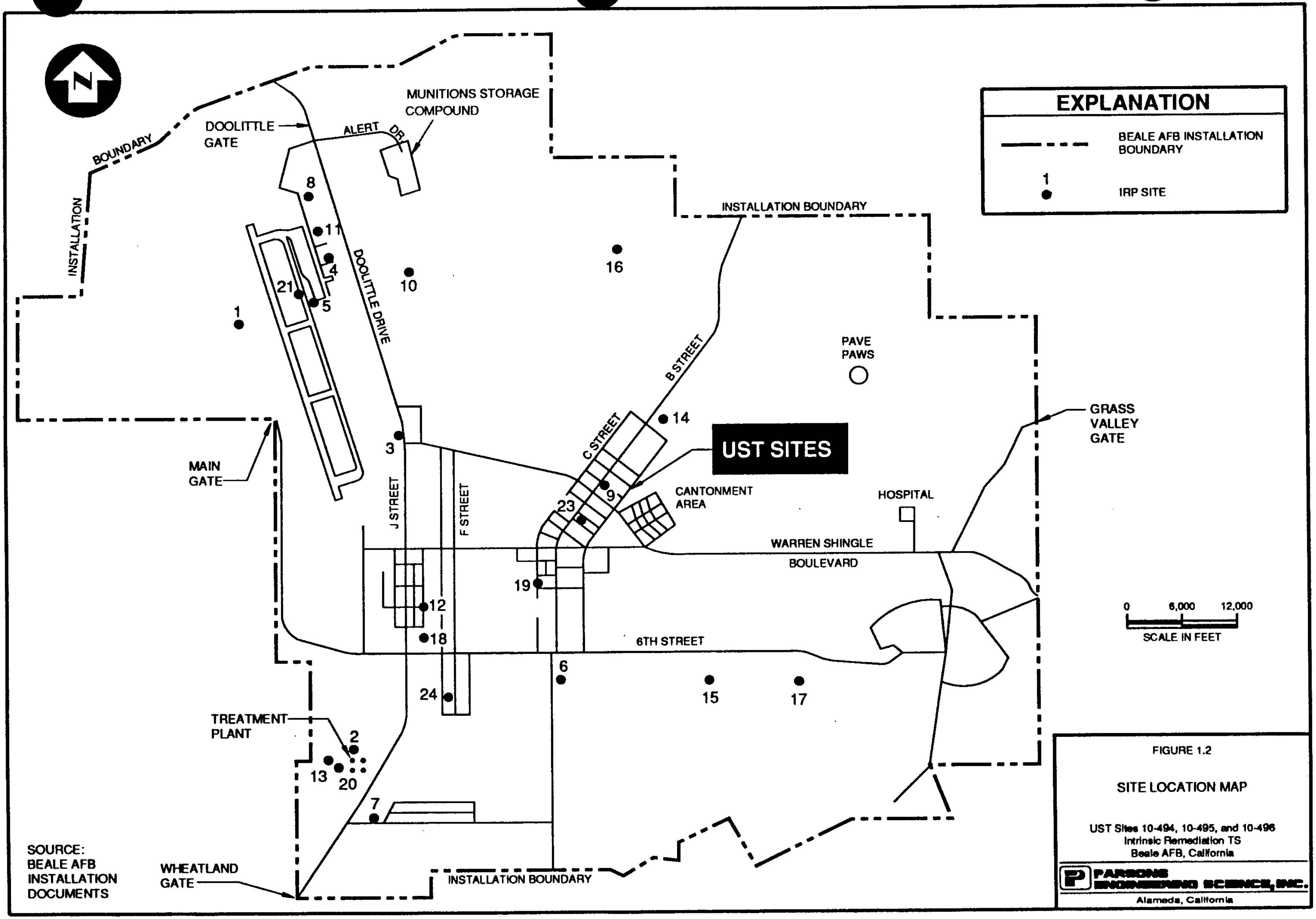


FIGURE 1.2

SITE LOCATION MAP

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

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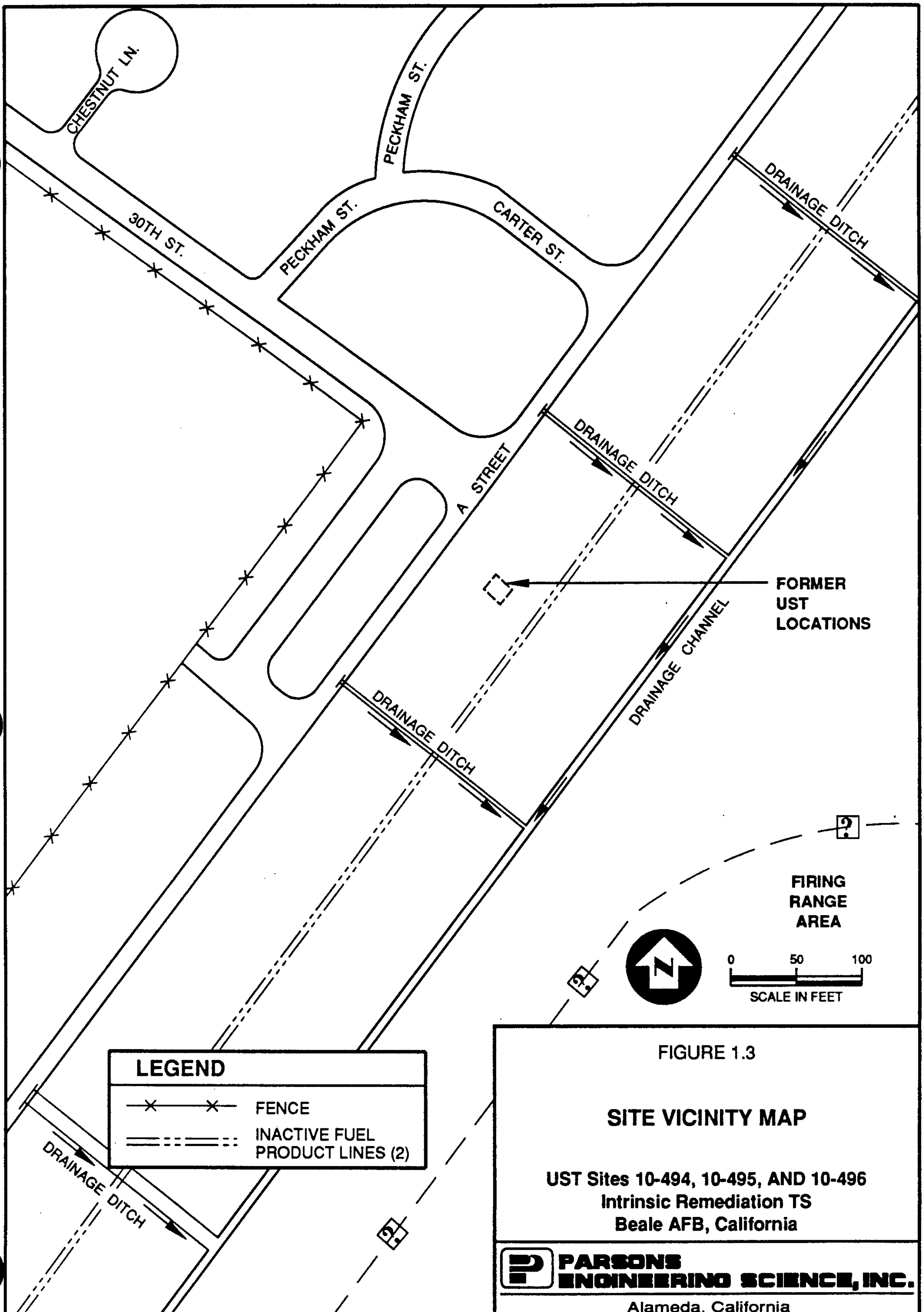


FIGURE 1.3

## SITE VICINITY MAP

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

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# SECTION 2

# SITE CHARACTERIZATION ACTIVITIES

This section presents the methods used by Parsons ES to collect additional site-specific data at Beale AFB. To meet the requirements of the RNA demonstration, additional data were required to evaluate the near-surface geology and hydrogeology, aquifer properties, and the nature and extent of contamination at the UST Site. Site activities included installing temporary groundwater monitoring points (MPs); collecting and analyzing soil, groundwater, and surface water samples; and measuring and estimating hydrogeologic parameters (static groundwater levels, groundwater gradient, groundwater flow direction, and hydraulic conductivity). The physical and chemical hydrogeologic parameters determined during field work activities included:

- Depth from measurement datum to the water table or potentiometric surface in existing monitoring wells and new monitoring points;
- Stratigraphic analysis of subsurface media;
- Rate of change of water elevation following rapid depression or elevation of water level in a monitoring well;
- Locations of potential groundwater recharge and discharge areas;
- Extent of residual petroleum hydrocarbon contamination in soils;
- Additional chemical analysis of soil, groundwater, and surface water for the parameters listed in Table 2.1.

Previously collected data and data collected under this program were integrated to aid with interpretation of the physical setting (Section 3) and contaminant distribution (Section 4), and to develop the conceptual site model (Section 5).

Twenty-two (22) temporary groundwater MPs were installed to further characterize the site and determine the extent of groundwater contamination. Procedures used to install the MPs and to collect soil core samples are described in Section 2.1. Procedures used to sample existing groundwater monitoring wells and newly installed temporary groundwater MPs are described in Section 2.2. Procedures used to sample surface water are described in Section 2.3. Sample handling procedures are described in Section 2.4.

Aquifer testing was performed during this investigation. Procedures used to conduct the aquifer slug tests are presented in Section 2.5. The calculated hydraulic conductivities from

# TABLE 2.1
# ANALYTICAL PROTOCOLS FOR GROUNDWATER, SURFACE WATER, AND SOIL SAMPLES
## UST Sites 10-494, 10-495, and 10-496
## Intrinsic Remediation TS
## Beale AFB, California

| MATRIX | METHOD | FIELD (F) OR ANALYTICAL LABORATORY (L) |
|---|---|---|
| **GROUNDWATER AND SURFACE WATER** * | | |
| Total Iron * | Colorimetric, HACH Method 8008 | F |
| Ferrous Iron ($Fe^{2+}$) * | Colorimetric, HACH Method 8146 | F |
| Ferric Iron ($Fe^{3+}$) * | Difference between total and ferrous iron | F |
| Manganese * | Colorimetric, HACH Method 8034 | F |
| Sulfide * | Colorimetric, HACH Method 8131 | F |
| Carbon Dioxide * | CHEMetrics Method 4500 | F |
| Alkalinity (Carbonate [CO3-2] and Bicarbonate [HCO3-1]) * | Titrimetric, HACH Method 8221 | F |
| Redox Potential | A2580B, direct reading meter | F |
| Dissolved Oxygen | E360.1, direct reading meter | F |
| pH | E150.1/SW9040, direct reading meter | F |
| Conductivity | E120.1/SW9050, direct reading meter | F |
| Temperature | E170.1, direct reading meter | F |
| Nitrate | E300.0 | L |
| Nitrite | E300.0 | L |
| Chloride | E300.0 | L |
| Sulfate | E300.0 | L |
| Alkalinity | E310.1 | L |
| Methane * | RSKSOP-175 | L |
| Total Organic Carbon * | E415.1 | L |
| Aromatic Hydrocarbons (including Trimethylbenzene) | SW8020A | L |
| Total Petroleum Hydrocarbons, as gasoline and diesel | SW8015M | L |
| Ammonia--Diss. Gas in Water * | E350.3 | L |
| **SOIL** | | |
| Total Organic Carbon | SW9060 | L |
| Grain-size distribution | ASTM-D422 | L |
| Moisture | ASTM D-2216 | L |
| Aromatic Hydrocarbons | SW8020A | L |
| Total Petroleum Hydrocarbons, as gasoline and diesel | SW8015M | L |

* Performed for groundwater samples only

the aquifer tests were used to estimate the velocity of groundwater and contaminants in the shallow saturated zone, and were used as input to the Bioplume II model. The calculated range of hydraulic conductivity values was used to guide the model sensitivity analysis. The remainder of Section 2 describes the procedures followed during TS field work activities. Additional details regarding investigative techniques are presented in the work plan for the site (Parsons ES, 1995).

## 2.1 MONITORING POINT INSTALLATION AND SOIL SAMPLE COLLECTION

Twenty-two (22) temporary groundwater MPs were installed using the Geoprobe® system in February/March 1996. The truck-mounted Geoprobe® system is a probe-driven sampler and is described in detail in Section 2.1.1.1. Soil samples were collected for lithologic description and laboratory analysis during installation of the MPs. Existing monitoring wells and the temporary MPs are shown on Figure 2.1.

Although the work plan called for four proposed MPs on the southeastern side of the main northeast/southwest drainage channel, site access problems at the time of field work prevented installation of these MPs. Two additional MPs called for in the work plan were not installed because field conditions indicated that the groundwater upgradient from the site could be adequately characterized with fewer MPs.

Nested MP clusters (i.e., multiple points installed at the same location and screened at different depths) were installed at three locations (MP-8/MP-9, MP-15/MP-16, and MP-17/MP-23). All shallow MPs were screened at the top of the shallow aquifer between approximately 5 and 10 feet bgs, generally in silty and/or gravelly fine- to coarse-grained sands. The deeper MPs at the nested MP clusters were constructed of stainless-steel screens. approximately 6 inches in length, and installed at approximately 17 feet bgs in the underlying clayey silt.

### 2.1.1 Installation Procedures and Determination of Stratigraphy

#### 2.1.1.1 Geoprobe® Direct-Push Technology

The Geoprobe® system is a hydraulically powered percussion/probing machine used to advance sampling tools through unconsolidated soils. This system provides for the rapid collection of soil, soil gas, and groundwater samples at shallow depths while minimizing the generation of investigation-derived waste (IDW) materials. Figure 2.2 is a diagram of the Geoprobe® system.

The probe-drive sampler serves as both the driving point and the sample collection device. and is attached to the leading end of the probe rods. To collect a soil sample, the sampler is pushed or driven to the desired sampling depth, the drive point is retracted, which opens the sampling barrel, and the sampler is subsequently pushed into the undisturbed soils. The soil cores are retained within brass, stainless steel, or clear acetate liners inside the sampling barrel. The probe rods are then retracted, bringing the sampling device to the surface. Soil

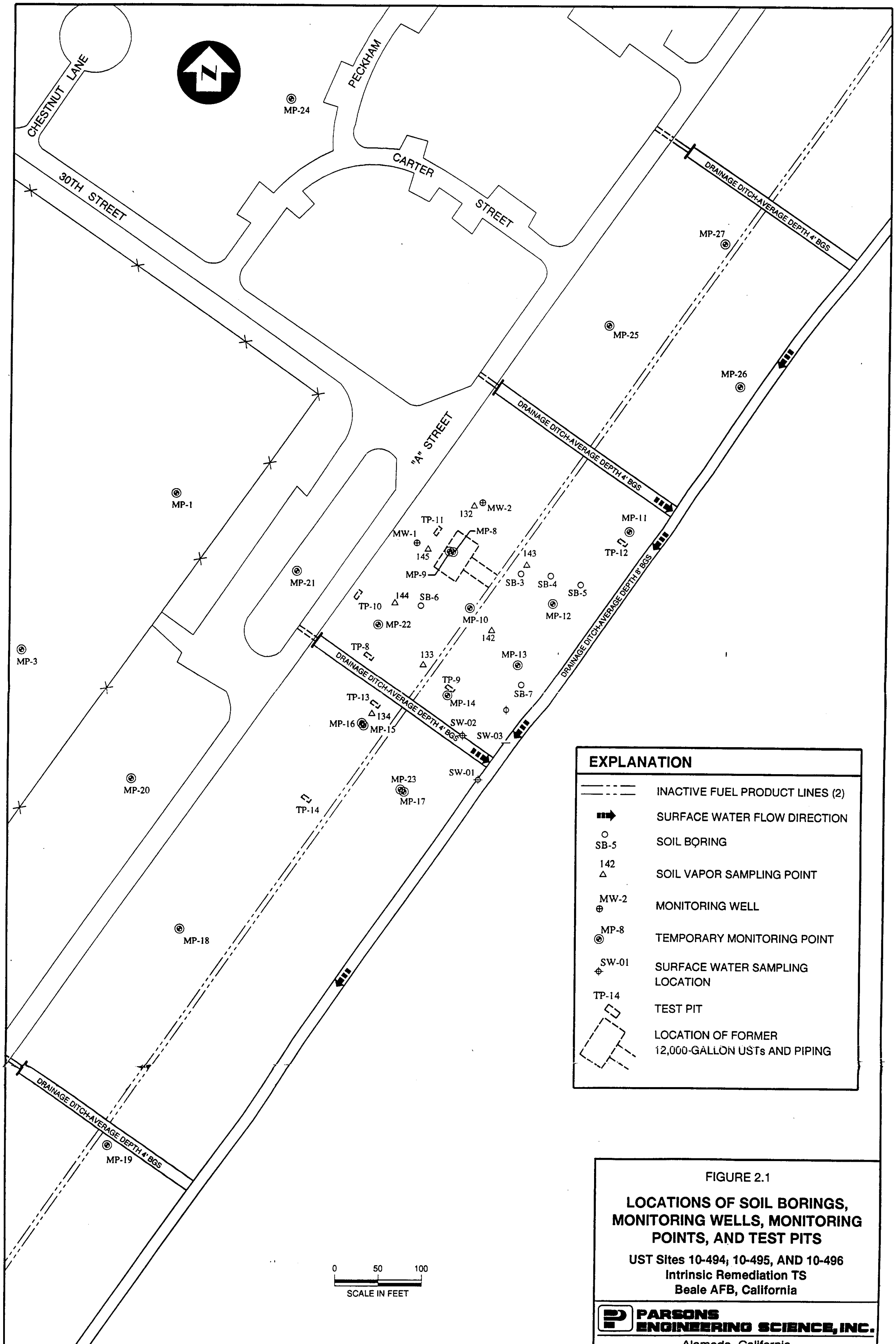


FIGURE 2.1

**LOCATIONS OF SOIL BORINGS, MONITORING WELLS, MONITORING POINTS, AND TEST PITS**

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

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Alameda, California

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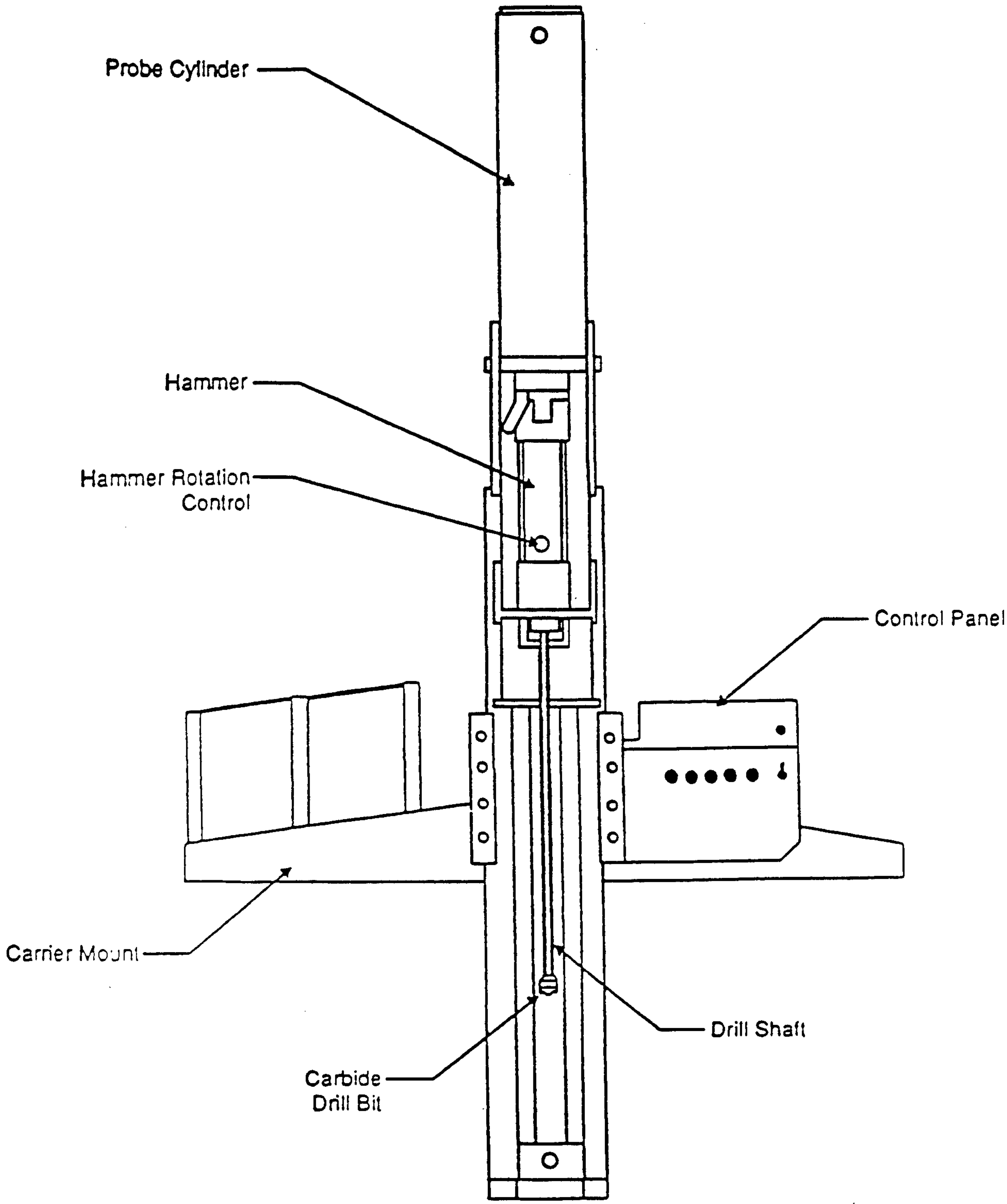


FIGURE 2.2

**CROSS SECTION OF GEOPROBE**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

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**Alameda, California**

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samples can then be extruded from the liners for logging or, when required, the liners can be capped, and undisturbed samples can be submitted to the analytical laboratory for testing.

#### 2.1.1.2 Determination of Stratigraphy

During installation of the MPs, a Parsons ES field scientist observed all field investigation activities and maintained a detailed descriptive log of all subsurface materials recovered during soil coring. The boring logs for the 22 MPs are included in Appendix A, and results are discussed in Section 3 and Section 4.

#### 2.1.1.3 Geoprobe® Equipment Decontamination

Prior to arriving at the site, probe rods, tips, sleeves, pushrods, samplers, tools, and other downhole equipment was decontaminated using a high-pressure, steam/hot water wash. Between sampling locations, equipment was decontaminated with a phosphate-free detergent and a potable water rinse, and allowed to air dry. Only potable water was used for decontamination.

All rinse water used for decontamination was placed in a temporary holding tank located northwest of the site. A low volume of soil cuttings (sampling waste) was generated during MP installation. Disposal of the soil cuttings and wastewater is discussed in Section 2.2.1.1.

### 2.1.2 Monitoring Point Installation and Construction

The 19 shallow MPs were installed by punching and sampling a borehole with the Geoprobe®. Upon removing the rods, the borehole depth was measured to determine if the hole remained open. All shallow MPs installed at the UST Site remained open after withdrawing the rods; therefore, the PVC casing and screen were placed at the appropriate depths, the annular space around the screen was filled with sand filter pack, and the annulus around the casing was filled with bentonite. The 19 shallow MPs were constructed using a 0.5-inch inside-diameter (ID)/0.75-inch outside-diameter (OD) polyvinyl chloride (PVC) screen and casing. Installed screens were 5 feet in length and factory-slotted with 0.010-inch openings. A sacrificial tip, screwed into the PVC screen, served as the bottom cap for the MP.

The 3 deep MPs in the nested MP clusters (MP-8, MP-16, and MP-23) were installed by punching and sampling a borehole to several feet above the target depth. The probe rods were withdrawn from the borehole, and the soil sampler was replaced with the well point assembly. An appropriate length of Teflon® tubing was threaded through the probe rods and attached to the well point. The assembly was lowered into the borehole and then driven down to the target depth. The probe rods were removed, leaving the sacrificial tip, screen assembly, and tubing behind. The annular space around the tubing was filled with granular bentonite. The 3 deep MPs were constructed using a sacrificial drive point attached to a 6-inch length of 0.5-inch-diameter stainless steel mesh screen, which was in turn connected to 0.375-inch Teflon® tubing.

Well materials were inspected for cleanliness prior to use. No glue or solvents were used. Construction details were noted on a Monitoring Point Installation Record form and are summarized in Appendix A.

### 2.1.3 Development

The MPs were developed prior to sampling to remove fine sediments from the portion of the formation adjacent to the MP screens. Development was accomplished using a peristaltic pump with new, dedicated high-density polyethylene (HDPE) tubing. The pump tubing was regularly lowered to the bottom of the MP so that fines were agitated and removed from the MP in the development water.

When a constant flow of groundwater could be obtained from an MP, development was continued until the groundwater was relatively free of fine sediments. Water was removed until pH, temperature, and water clarity (turbidity) stabilized. Monitoring point development occurred a minimum of 24 hours prior to sampling. All development waters and purge waters were handled as detailed in Section 2.2.1.1.

### 2.1.4 Site Restoration and Monitoring Point Abandonment

After the MPs were installed and sampled, each location was restored as closely to its original condition as possible. All MPs were abandoned by sealing with a bentonite-cement grout hydrated with potable water to eliminate any creation or enhancement of contamination migration pathways to the groundwater.

## 2.2 GROUNDWATER SAMPLING

Groundwater samples were collected at the 2 existing monitoring wells (MW-1 and MW-2) and 18 of the 22 newly-installed MPs (Figure 2.1). A total of 4 MPs — MP-1, plus all 3 of the deep MPs (MP-8, MP-16, and MP-23) — could not be sampled because a sufficient volume of groundwater could not be obtained.

Groundwater samples were analyzed by Parsons ES field scientists for dissolved oxygen (DO), reduction/oxidation potential (redox), total iron, ferrous iron, soluble manganese, free carbon dioxide, temperature, pH and electrical conductivity. Analyses for total petroleum hydrocarbons (TPH), and volatile aromatics (including BTEX) were performed by Curtis and Tompkins of Berkeley, California. Analyses for nitrate, nitrite, sulfate, methane, alkalinity, dissolved ammonia, chloride, and total organic carbon (TOC) were performed by Evergreen Analytical Laboratory, Inc. (EAL) of Wheatridge, Colorado.

Groundwater sampling forms were used to document the specific details of the sampling event for each well and MP. Groundwater sampling results from the analytical laboratory are included as Appendix C. Results for groundwater sampling previously conducted are included in Appendix B.

This section describes the procedures used for collecting groundwater samples. In order to maintain a high degree of quality control (QC) during this sampling event, the procedures

described in the site work plan (Parsons ES, 1995) and summarized in the following sections were followed.

### 2.2.1 Preparation for Sampling

All equipment to be used for sampling was assembled and properly cleaned and calibrated (if required) prior to arriving in the field. Special care was taken to prevent contamination of the groundwater and extracted samples. The two primary ways in which sample contamination can occur are through contact with improperly cleaned equipment and through cross-contamination due to insufficient cleaning of equipment between wells and monitoring points. To prevent such contamination, downhole sampling equipment and the water level probe and cable used to determine static water levels were thoroughly cleaned before and after field use and between uses at different sampling locations according to the procedures presented in Section 2.2.1.1.

#### 2.2.1.1 Equipment Decontamination and Waste Disposal

All portions of sampling and test equipment that were used for sampling or were used downhole were thoroughly cleaned before each use. This included the Geoprobe® soil sampling tool, pump tubing, water level probe and cable, lifting line, and other equipment or portions thereof that came into contact with the samples. Based on the types of sample analyses conducted, the following cleaning protocol was used:

- Washed with potable water and phosphate-free laboratory detergent;
- Rinsed with potable water;
- Rinsed with isopropyl alcohol; and
- Rinsed with distilled or deionized water.

When precleaned, disposable sampling equipment was used, the cleaning protocol specified above was not required. Laboratory-supplied sample containers were cleaned and sealed by the laboratory. The type of container provided and the method of container decontamination was documented in the permanent record of the sampling event. Any deviations from these procedures were documented in the field scientist's field notebook and on the groundwater sampling record.

All purge water, decontamination rinseate, and other wastewaters were placed in a temporary holding tank located northwest of the site. Approximately 150 gallons of water was generated during installation of the MPs and sampling activities. After sampling activities were completed, the water was sampled, analyzed, and discharged at the Base treatment pad for contaminated soils located near the intersection of 9th Street and J Street and operated by Metcalf & Eddy. All soil cuttings generated during MP installation also were removed to the Base treatment pad.

#### 2.2.1.2 Equipment Calibration

As required, field analytical equipment was calibrated according to the manufacturers' specifications prior to field use. Calibration records for field analytical equipment were maintained by Parsons ES, and field calibrations were recorded in the field notebook. Calibration was required for equipment used for onsite measurements of DO, pH, electrical conductivity, temperature, redox potential, ferrous iron ($Fe^{2+}$), and other field parameters listed in Table 2.1.

#### 2.2.1.3 Preparation of Location

Prior to proceeding with the sampling, the areas around the existing monitoring wells (MWs) and new MPs were cleared of foreign materials, such as brush, rocks, and debris. These procedures prevented sampling equipment from inadvertently contacting debris around the sampling location. Any irregularities with the protective cover, cap, lock, external surface seal, internal surface seal, well identification, well datum, and pad for existing MWs were noted.

#### 2.2.1.4 Water Level and Total Depth Measurements

Prior to removing any water from the MWs or MPs, the static water level was measured. An electric water level probe was used to measure the depth to groundwater below the datum to the nearest 0.01 foot. After measuring the static water level, the water level probe was slowly lowered to the bottom of the monitoring well/point and the depth was measured to the nearest 0.01 foot. Based on these measurements, the volume of water to be purged from the MW or MP was calculated. Water levels used to develop the site groundwater potentiometric surface map presented in Section 3 were taken at the conclusion of all field activities on 20 March 1996.

### 2.2.2 Purging and Sample Collection

MW and MP purging consisted of the removal of at least three casing volumes of water prior to sample collection. A peristaltic pump was used for MW and MP purging. Once three casing volumes of water were removed from the MW or MP, purging continued until the temperature, redox potential, electrical conductivity, pH, and DO concentrations had stabilized, and if possible, until the purge water became clear.

When sufficient water was available, sample collection commenced immediately after completion of the purge. In all instances, groundwater samples were collected within 24 hours of the purge. Groundwater samples were extracted with a peristaltic pump. Sample containers were filled directly from the pump discharge tube. The groundwater was directed toward the bottle wall near the top and allowed to run down the inner walls of the sample bottle in order to minimize aeration of the sample. Sample containers were completely filled so that no air space remained in the container.

### 2.2.3 Onsite Chemical Parameter Measurement

As indicated in Table 2.1, many of the groundwater chemical parameters were measured on site by Parsons ES field scientists. Some of the measurements were made with direct-reading meters, while others were made using a Hach® portable colorimeter in accordance with specific Hach® analytical procedures. These measurements are briefly summarized in the following sections; more detailed descriptions are provided in the work plan for the TS (Parsons ES, 1995).

#### 2.2.3.1 Dissolved Oxygen Measurements

DO measurements were made during purging and immediately prior to groundwater sample acquisition in a flow-through cell using a direct-reading meter (YSI® model 33). DO concentrations were recorded after each volume was purged. The stable value recorded at the end of the purge was assumed to represent the aquifer characteristics at each location.

#### 2.2.3.2 pH, Temperature, and Specific Conductance

Because the pH, temperature, and specific conductance of a groundwater sample can change significantly within a short time following sample acquisition, these parameters were measured in the field in unfiltered, unpreserved "fresh" water collected by the same technique as the samples taken for laboratory analyses. The measurements were made with direct-reading meters in a flow-through cell or a clean glass container separate from those intended for laboratory analysis, and the measured values were recorded in the groundwater sampling record.

#### 2.2.3.3 Carbon Dioxide Measurements

The presence of free carbon dioxide dissolved in groundwater is unlikely because of carbonate buffering; however, carbon dioxide concentrations in the dissolved contaminant plume should be compared to background concentrations to determine whether they are elevated. Carbon dioxide concentrations in groundwater were measured in the field by Parsons ES scientists via titrimetric analysis using Hach® Method 8223.

#### 2.2.3.4 Total Iron, Ferrous Iron, and Ferric Iron Measurements

Iron is an important trace nutrient for bacterial growth, and different valence states of iron can affect the redox potential of the groundwater and act as an electron acceptor for biological metabolism under anaerobic conditions. Iron concentrations were measured in the field via colorimetric analysis with a Hach® DR/700 Portable Colorimeter after appropriate sample preparation. Hach® Method 8008 for total soluble iron (0 to 3.0 milligrams per liter [mg/L] $Fe^{3+}$ + $Fe^{2+}$) and Hach® Method 8146 for ferrous iron (0 to 3.0 mg/L $Fe^{2+}$) were used to prepare and quantitate the samples. Ferric iron ($Fe^{3+}$) was quantitated by subtracting ferrous iron concentrations from the total iron concentration.

#### 2.2.3.5 Manganese Measurements

Manganese is a potential electron acceptor under anaerobic environments. Manganese concentrations were measured in the field using colorimetric analysis with a Hach® DR/700 Portable Colorimeter. USEPA-approved Hach® Method 8034 (0 to 20.0 mg/L Mn) was used for quantitation of manganese concentrations.

#### 2.2.3.6 Redox Potential

The redox potential of groundwater is an indication of the relative tendency of a solution to accept or transfer electrons. Redox reactions in groundwater are usually biologically mediated; therefore, the redox potential of a groundwater system depends upon and influences rates of biodegradation. Redox potential can be used to provide real-time data on the location of the contaminant plume, especially in areas undergoing anaerobic biodegradation. The redox potential of a groundwater sample taken inside the contaminant plume should be somewhat less than that taken upgradient or crossgradient from the plume.

The redox potential of a groundwater sample can change significantly within a short time following sample acquisition and exposure to atmospheric oxygen. Therefore, this parameter was measured in the field in a flow-through cell by the same technique used for DO measurements.

## 2.3 SURFACE WATER SAMPLING

### 2.3.1 Preparation of Location

Three surface water samples (SW-01 through SW-03, Figure 2.1) were collected from the drainage ditches located downgradient from the site. The samples were collected near the southeastern corner of the site in order to assess the impact of groundwater seeps along the bank on the surface water quality. The location and elevation along the drainage channel where surface water samples were taken were marked with a construction stake for future reference by the surveyor.

Prior to starting the sampling procedure, the lengths of the drainage channels were inspected for evidence of surface water contamination, such as sheens on the water surface, seepage fronts along the upgradient banks of the channels, stained soils, and odors. No such evidence was found.

### 2.3.2 Sample Collection

Surface water samples were collected using a peristaltic pump. The tubing leading to the pump was placed beneath the water surface and kept below the water surface during sample collection to minimize aeration of the sample. Sample containers were filled directly from the pump discharge tube. The order of sample collection was from downstream to upstream to minimize the potential effects of sample collection disturbances on subsequent samples.

## 2.4 SAMPLE HANDLING FOR LABORATORY ANALYSIS

This section describes the handling of samples from the time of sampling until the samples were delivered to the fixed-base laboratory. For this study Curtis and Tompkins of Berkeley, California and EAL of Wheatridge, Colorado provided analytical laboratory support. Fixed-base analytical methods and field methods used for surface water samples consisted of a subset of those used for groundwater samples and are listed in Table 2.1.

### 2.4.1 Sample Preservation

All necessary sample containers were provided by the laboratories, and necessary chemical preservatives were added to the sample containers by the laboratories prior to shipment to the site. Samples were prepared for transportation to the laboratories by placing the samples in a cooler containing ice to maintain a shipping temperature of approximately 4 degrees centigrade (°C). Samples were delivered to Curtis and Tompkins and EAL via overnight courier to ensure that the temperature remained constant and that all sample holding times were met.

### 2.4.2 Sample Container and Labels

Sample containers and appropriate container lids were provided by the laboratories. The sample containers were filled as described in Sections 2.2.2 and 2.3.2, and the container lids were tightly closed. The sample label was firmly attached to the container side, and the following information was legibly and indelibly written on the label:

- Facility name;
- Sample identification;
- Sample type (e.g., groundwater);
- Sampling date;
- Sampling time;
- Preservatives added;
- Sample collector's initials; and
- Requested analyses.

### 2.4.3 Sample Shipment

After the samples were sealed and labeled, they were packaged for transport to the laboratories. The following packaging and labeling procedures were followed:

- Samples were packaged to prevent leakage or vaporization from their containers;
- Samples were cushioned to avoid breakage; and
- Ice was added to the shipping container to keep samples cool.

The packaged samples were delivered by overnight courier to the analytical laboratories.

### 2.4.4 Chain-of-Custody Control

After the samples were collected, chain-of-custody procedures were followed to establish a written record of sample handling and movement between the sampling site and the analytical laboratory. Each shipping container contained the chain-of-custody form completed by the sampling personnel. This form is a part of the permanent record for the samples and was returned with the sample analytical results. The chain-of-custody form contains the following information:

- Sample identification number;
- Sample collectors' printed names and signatures;
- Date and time of collection;
- Place and address of collection;
- Sample matrix;
- Chemical preservatives added;
- Analyses requested;
- Signatures of individuals involved in the chain of possession; and
- Inclusive dates of possession.

The chain-of-custody documentation was placed inside the shipping container so that it was immediately apparent to the laboratory personnel receiving the container without risk of being lost or damaged during transport. The shipping container was sealed so that it was obvious if the seal had been tampered with or broken.

## 2.5 AQUIFER TESTING

Slug tests were conducted on the two existing MWs at the site (MW-1 and MW-2). Slug tests are single-well hydraulic tests used to determine the hydraulic conductivity of an aquifer in the immediate vicinity of the tested well. This information is required to accurately estimate the velocity of groundwater and contaminants in the shallow saturated zone. Slug tests can be used for both confined and unconfined aquifers that have a transmissivity of less than 7,000 square feet per day ($ft^2$/day).

Slug testing can be performed using either a rising head or a falling head test. At this site, two rising head and two falling head tests were performed at each well. Detailed slug testing procedures are presented in the *Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Ground Water* (Wiedemeier *et al.*, 1995), hereafter referred to as the Technical Protocol document.

Data obtained during slug testing were analyzed using AQTESOLV software (Geraghty & Miller, 1991) and the methods of Bouwer and Rice (1976) and Cooper *et al.* (1967) for confined conditions. The results of slug testing are presented in Section 3.3.2.2.

## 2.6 SURVEYING

All MPs, MWs, and surface water sampling locations were surveyed by Phillippi Engineering, Inc. (PEI) of Vacaville, California. All horizontal coordinates and ground surface elevations were surveyed to at least the nearest 0.01 foot relative to a Base datum. In addition, the top-of-casing elevation (measurement datum) for MPs was surveyed to the nearest 0.01 foot.

# SECTION 3

# PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section incorporates data collected by Parsons ES during field activities in support of remediation by natural attenuation (RNA) with data documented in previous reports on Beale AFB. Descriptions of regional topography, surface water hydrology, geology, and hydrogeology were taken from previous reports (CH2M Hill, 1991; LAW, 1995). Investigative techniques used to determine the physical characteristics of the site are discussed in Section 2.

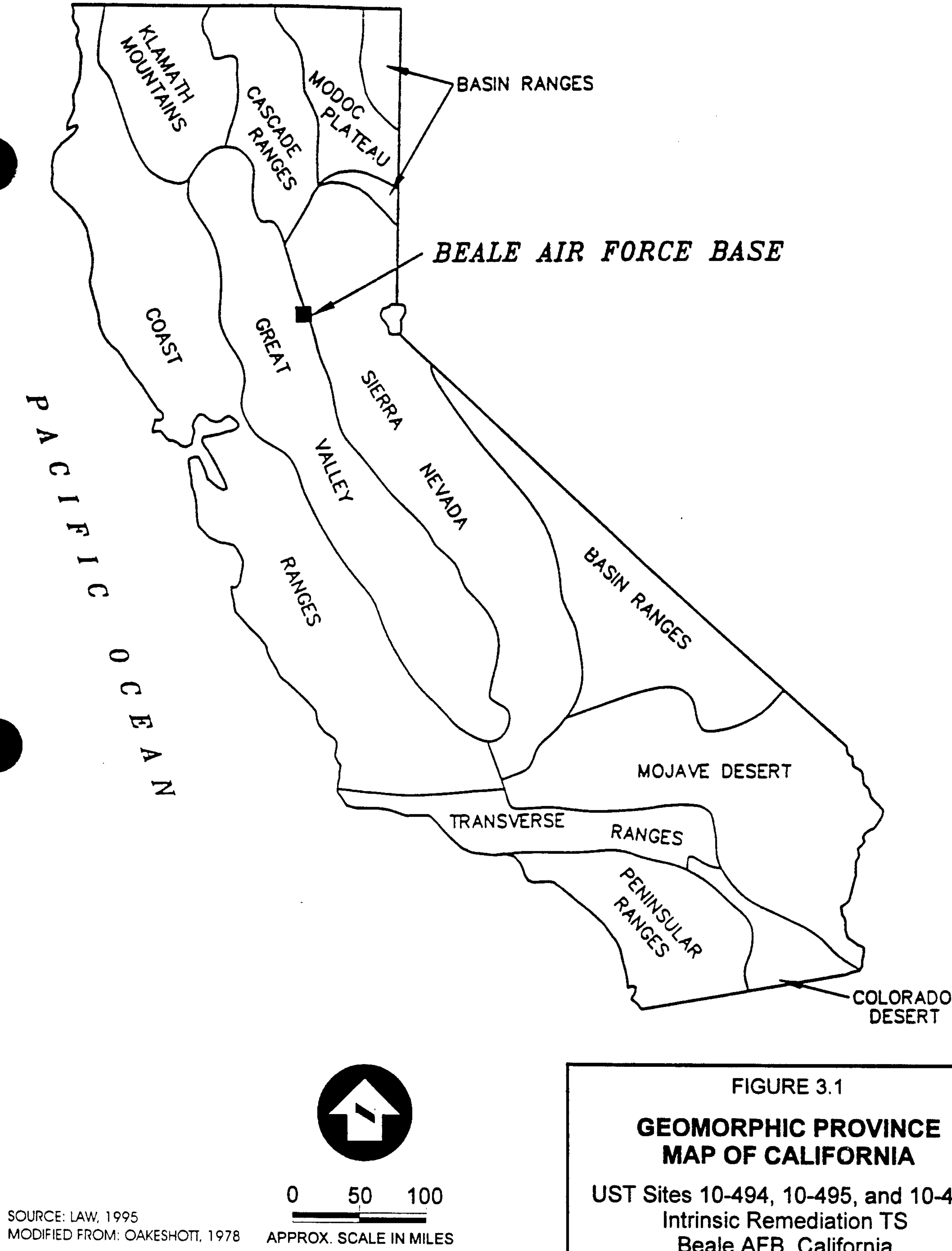
## 3.1 SURFACE FEATURES

### 3.1.1 Topography and Surface Water Hydrology

Beale AFB is located on the eastern edge of the Sacramento Valley along the border of two geomorphic provinces: the Great (or Central) Valley to the west, and the Sierra Nevada to the east (Figure 3.1). The Great Valley Province is a nearly flat alluvial plain, approximately 450 miles long and 50 miles wide. The western portion of Beale AFB consists of generally flat plain, typical of the Great Valley Province. The Sierra Nevada Province consists of a north-northwesterly trending mountain range, approximately 400 miles long and 50 to 80 miles wide, with a shallow western slope and a steep eastern escarpment. The eastern portion of the Base has generally west-facing slopes and consists of rolling hills typical of the western foothills of the Sierra Nevada Mountains. Elevations on the Base range from approximately 80 feet above mean sea level (msl) in the west to approximately 600 feet above msl in the east.

The regional drainage pattern follows the topography, with surface water east of the Base generally flowing east to west, and surface water west of the Base generally flowing north to south. The primary drainages are the Yuba River, Bear River, Feather River, and the Sacramento River. The Yuba River, north of the Base, and the Bear River, south of the Base, flow into the Feather River, west of the Base (Figure 3.2). The Feather River drains predominately north to south and flows into the Sacramento River, which eventually flows westward through the Carquinez Straits, San Pablo Bay, and San Francisco Bay to the Pacific Ocean.

Surface drainage at Beale AFB follows the general northeast to southwest slope of the ground surface. Figure 3.3 shows the distribution of lakes, creeks, and tributaries on the Base. Much of the surface water runoff is conveyed by three main creeks: Dry Creek, Hutchison Creek, and Reeds Creek. Because of the presence of locally impermeable clay substrates in the soil profile, ephemeral vernal pools form over much of Beale AFB




SOURCE: LAW, 1995
MODIFIED FROM: OAKESHOTT, 1978

FIGURE 3.1

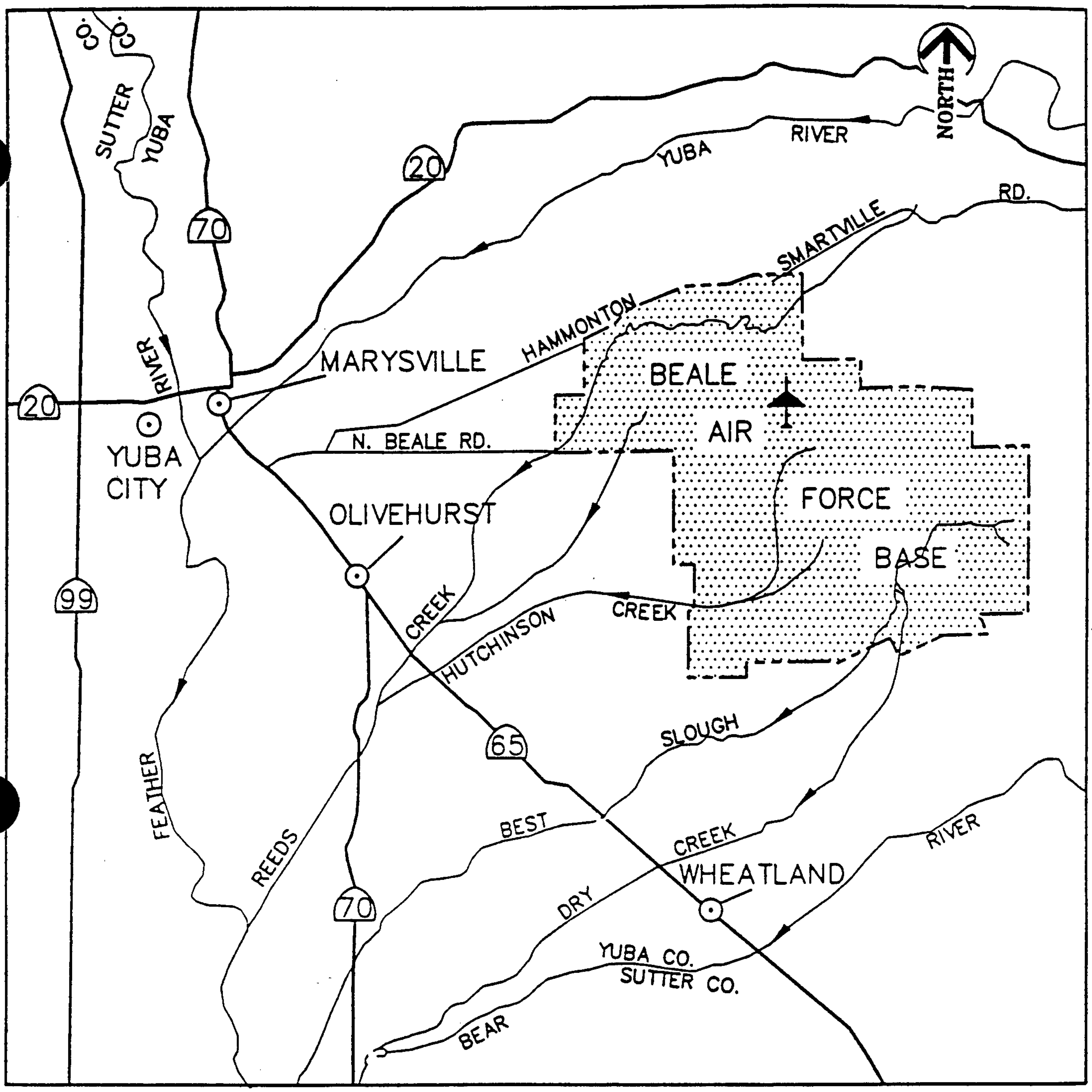
**GEOMORPHIC PROVINCE MAP OF CALIFORNIA**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_P8.CDR 10/28/96




SOURCE: LAW, 1995
MODIFIED FROM: PAGE, 1980

0 1.5 3
APPROX. SCALE IN MILES

FIGURE 3.2

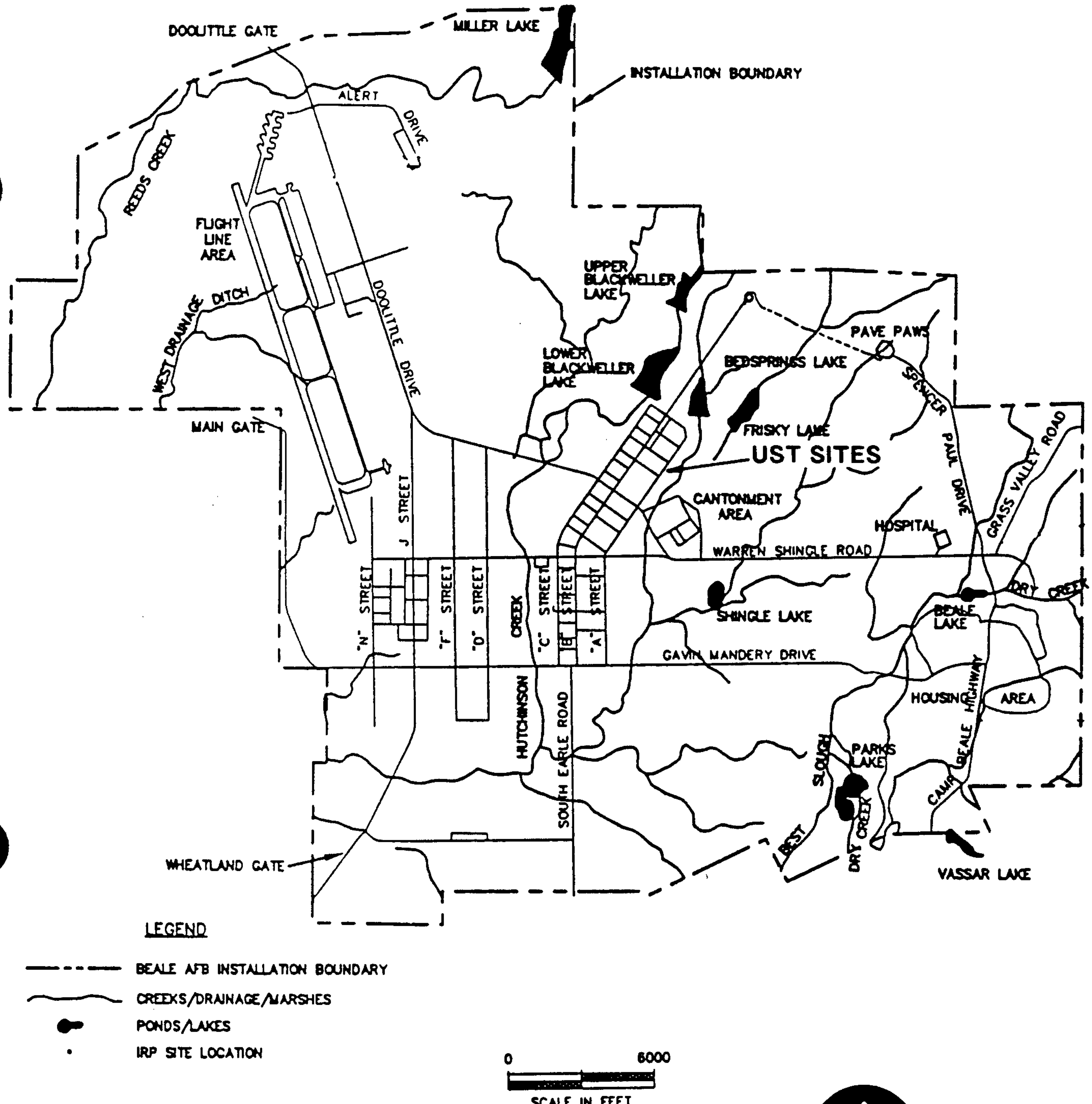
**REGIONAL SURFACE HYDROLOGY**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_P8.CDR 10/28/96




SOURCE: LAW, 1995
MODIFIED FROM: SAC MASTER PLAN, BEALE AFB, MAY 1993

FIGURE 3.3

**DRAINAGES AND LAKES**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_P8.CDR 10/28/96

following winter rains. These pools, and most of the creeks and tributaries, dry up in the summer. Reeds Creek and Hutchison Creek join and flow into the Feather River. Dry Creek flows into the Bear River, which then flows into the Feather River.

### 3.1.2 Manmade Features

The land surface at the site is relatively undisturbed and is vegetated with grass. A large drainage channel, approximately 8 feet in depth and 10 to 15 feet wide, borders the site to the southeast (Figure 2.1). Several shallower drainage ditches, approximately 4 feet in depth and 5 feet wide, cut northwest to southeast and join the larger drainage channel. The smaller drainage ditches dry up in the spring after the end of the winter rains and, therefore, are assumed to exhibit losing stream features with respect to the aquifer. The large drainage channel flows year round and, therefore, is assumed to exhibit gaining stream features with respect to the aquifer. However, water depth, flow volume, and velocity are significantly lower during the summer months.

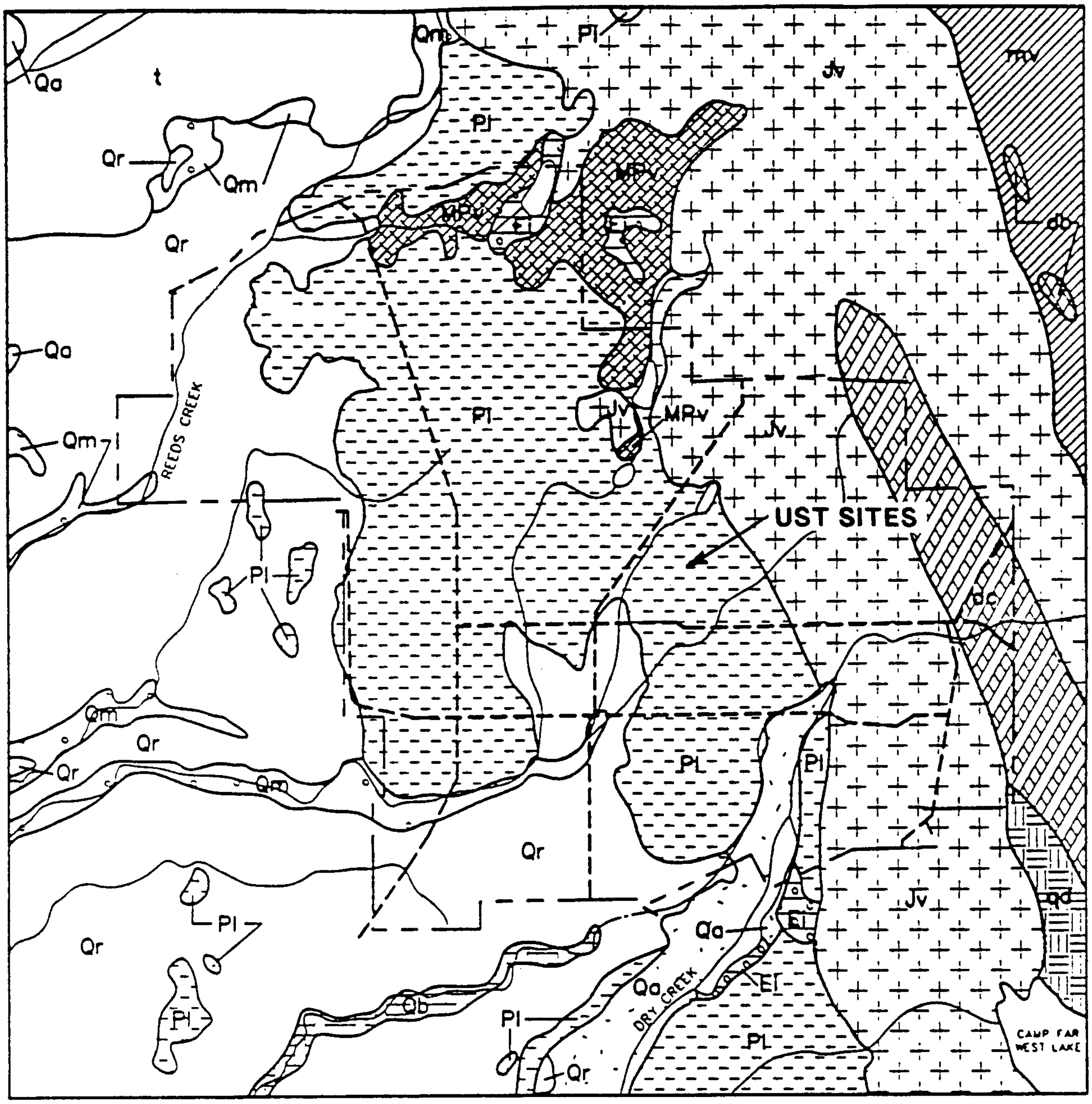
As discussed in Section 1.2, a compost pit existed at the site in the former tank excavation pit until November 1995. The fuel pipelines that supplied the USTs are inactive but are still in place. These lines run through the site parallel to the large drainage channel (Figure 2.1). The location of the pipeline is noticeable in some areas of the site due to the raised land surface.

## 3.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

Rocks that underlie the Sacramento Valley and border the foothills of the Sierra Nevada include weakly metamorphosed plutonic, sedimentary, and volcanic rocks of Paleozoic and Mesozoic age; sedimentary and volcanic rocks of Mesozoic and Cenozoic age; and unconsolidated alluvium of Quaternary age.

The geology of the area reflects the boundary between the Sierra Nevada and the Great Valley geomorphic provinces. The Sierra Nevada Province is composed of a westward tilting crustal block of the Sierra batholith consisting of primarily Jurassic to Cretaceous plutonic rocks. To the west of these plutonic rocks is a belt of weakly metamorphosed sedimentary and volcanic rocks of Paleozoic and Mesozoic age. The Great Valley Province is composed of an elongated structural trough filled with a thick sequence of Jurassic to Recent age sediments. In the eastern part of the valley, including Beale AFB, these deposits are derived from and overlie the metamorphic and igneous rocks of the Sierra Nevada. The sediment deposits reach a maximum thickness of 60,000 feet in the Central Valley.

The geologic units in the vicinity of the Base include undifferentiated Cretaceous units and Tertiary and Quaternary formations, as shown on Figure 3.4. The Tertiary and Quaternary units found in the vicinity of the Base, from oldest to youngest, include the Capay, Ione, Wheatland, Mehrten, Neroly, Laguna, Riverbank, and Modesto Formations, and Holocene deposits. A description of these units is included in the generalized stratigraphic column presented in Table 3.1.




LEGEND

| | |
|---|---|
| t | Holocene Dredge or Mine Tailings |
| Qa | Holocene Natural Levee and Channel Deposits |
| Qb | Holocene Basin Deposits |
| Qm | Pleistocene Modesto Formation |
| Qr | Pleistocene Riverbank Formation |
| Pl | Pliocene Laguna Formation |
| MPv | Miocene–Pliocene Volcanic Rocks |
| El | Eocene Ione Formation |
| Jv | Jurassic Volcanic Rocks Predominantly Metamorphosed Mafic to Felsic Pyroclastic Rock |
| mv | Jurassic Volcanic Rocks Predominantly Pyroclastic and Volcanic Rock |
| qd | Jurassic Quartz Diorite and Tonalite |
| dc | Jurassic Dike Complex |
| db | Jurassic Massive Diabase |
| --- | Road |

0 8000

APPROXIMATE SCALE IN FEET

SOURCE: LAW, 1995
MODIFIED FROM: SAUCEDO AND WAGNER, 1992

FIGURE 3.4

**BASEWIDE GEOLOGIC MAP**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_P8.CDR 10/28/96

# TABLE 3.1
# GENERALIZED STRATIGRAPHIC COLUMN
## UST Sites 10-494, 10-495, and 10-496
## Intrinsic Remediation TS
## Beale AFB, California

| Formation | Age of Formation | Description | References |
|---|---|---|---|
| Recent Deposit | 0 to 11,000 years Holocene | Unconsolidated alluvial silt, sand, and gravel and overbank clay, silt, and fine-grained sand. | Page, 1980 |
| Modesto | 9,000 to 42,000 years Holocene to Pleistocene | Alluvial, fluvial, and possibly lacustrine sand, silt, and clay with minor gravel | Busacca, 1982 |
| Riverbank | 150,000 to 450,000 years Pleistocene | Fluvial silt, sand, and gravel derived from erosion of the Laguna Formation | Busacca, 1982 |
| Laguna | 1.6 to 3.4 m.y. Pleistocene to Pliocene | Heterogeneous assemblage of silt, clay, sand and minor siliceous gravel beds. Predominantly reddish to yellowish-brown silt to sand silt with abundant clay and minor intervals of tuff. | Redwine, 1972 |
| Neroly | 5 to 22 m.y. Pliocene to Late Miocene | Volcanic fluvial deposits ranging from volcanoclastic cobble conglomerate to sandstone and clayey siltstone, with minor intervals of tuff. | Unruh, 1990 |
| Mehrten | 5 to 22 m.y. Pliocene to Late Miocene | Volcanic mudflow debris and pyroclastic flows deposited on the western front of the Sierra Nevada. The sediments are predominantly andesitic, but range from basaltic to rhyolitic. | Clark & Anderson, 1938; Redwine, 1972 |
| Wheatland | 25 to 38 m.y. Oligocene | Predominantly a tuffaceous sandstone with basal conglomerate containing marine fossils. The sandstone is overlain by thinly bedded fissile, tuffaceous lignitic shale. Near the top of the section lies a pink volcanic mudflow with subangular volcanic clasts. The top of the formation consists of well-bedded spheroidal shale with interbeds of lignite containing carbonized reeds. | Unruh, 1990 |
| Ione | 44 to 45 m.y. Early to Middle Eocene | A light-colored anauzitic sandstone and clay-stone, dark reddish-brown or brown ferruginous sandstone, quartz, and metamorphic gravel, and conglomerate with minor lignite. | Redwine, 1972; Unruh, 1990 |
| Capay | 50 to 55 m.y. Early Eocene | Dark greenish-gray, fossiliferous siltstone, clayey siltstone, and sandy siltstone with occasional sand and fine gravel. | |

Notes:
m.y. - million years

Source: Law 1995

Surface soils consist primarily of three different types of loam: moderately deep to deep loam formed in alluvium (Perkins loam); shallow to moderately deep gravelly loam with cobbles (Pardee loam); and small areas of shallow to moderately deep fine-grained soils (Auburn loam). A map of surface soils is shown on Figure 3.5. Permeability is typically low to moderate.

Water-bearing deposits in the Sacramento Valley and in the vicinity of the Base consist primarily of the non-marine, valley-filling late Tertiary and Quaternary sediments. Water-bearing deposits in the vicinity of Beale AFB are the Neroly, Laguna, Riverbank, and Modesto Formations, and Holocene-age alluvial deposits. These water-bearing zones range in thickness from approximately 1,000 feet in the vicinity of the Feather River to less than 300 feet in the vicinity of the Sierra Nevada foothills. At Beale AFB, the volcaniclastic Neroly sediments beneath the Laguna Formation are the most productive water-bearing zones. Groundwater also is found in the metamorphosed volcanic rocks of the Sierra Nevada foothills, primarily in the fractures.

In the Sacramento Valley and on the Base, groundwater conditions are generally unconfined. However, locally confined and/or perched zones can occur in areas where sands and gravels are found with less permeable silts and clays. In general, flow in the Sacramento Valley is toward the center of the valley. However, groundwater pumping has depressed the groundwater table in portions of the Sacramento Valley and has created localized flow conditions that do not follow the regional topography.

Groundwater elevations at the Base range from approximately 20 feet above msl in the western area of the Base to approximately 140 feet above msl in the eastern area (Figure 3.6). Groundwater flow is generally to the southwest. Extensive pumping in the area has influenced groundwater flow directions.

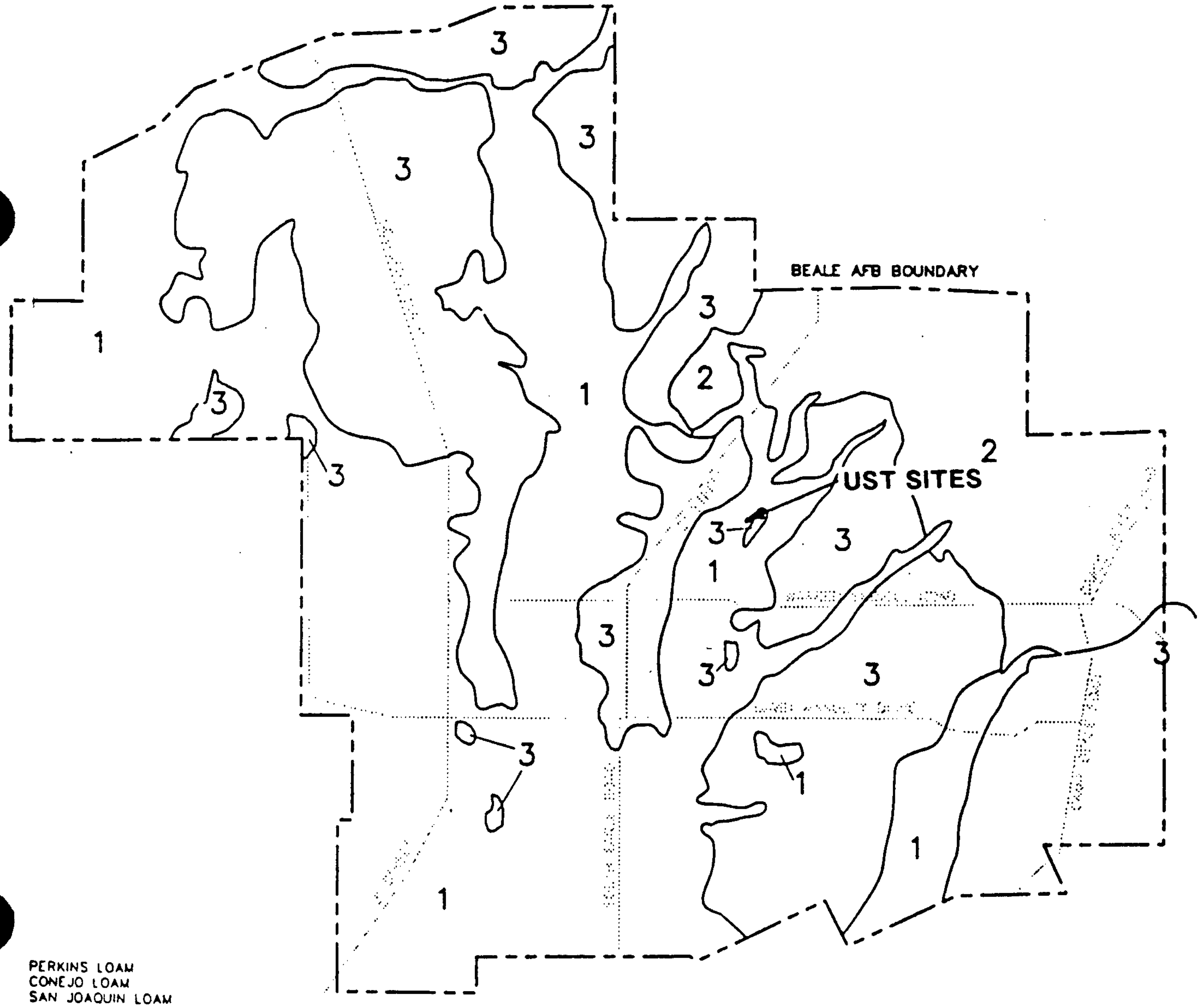
## 3.3 SITE GEOLOGY AND HYDROGEOLOGY

### 3.3.1 Lithology and Stratigraphic Relationships

The uppermost geologic unit in the western portion of Beale AFB, which includes the UST Site, has been mapped as Laguna Formation. This formation consists of a Plio-Pleistocence alluvial sequence of silt, sand, clay, and unsorted gravel. These deposits overlie older volcanic rocks that outcrop in the Sierra Nevada foothills to the east.

Evaluation of the site-specific geology is based on the logs from soil borings advanced during the current investigation and during a preliminary investigation by Metcalf & Eddy (1995) (Figures 3.7 through 3.9 and Appendix A).

Soils in the vicinity of the UST Site consist of interbedded clays, silts, sands, and gravels. The cross-sections (Figures 3.8 and 3.9) generally show a surficial layer across the site consisting of gravelly and sandy clay and silt to a depth of approximately 5 feet bgs. This layer is underlain by a unit of coarse-grained sediments, consisting of silty and/or gravelly fine- to coarse-grained sands. The gravels and sands generally end at a depth of 8 to 10 feet bgs and are underlain by silty clay or clayey silt to approximately 11 to 15 feet bgs. A lower




1 PERKINS LOAM
CONEJO LOAM
SAN JOAQUIN LOAM

2 AUBURN LOAM
ARGONAUT-AUBURN COMPLEX
AUBURN-SOBRANTE COMPLEX

3 PARDEE LOAM
PARDEE VARIANT COMPLEX
REDDING-CORNING COMPLEX
REDDING LOAM

0 6000
APPROXIMATE SCALE IN FEET

SOURCE: LAW, 1995
MODIFIED FROM: USDA SOIL CONSERVATION SERVICE, 1985

FIGURE 3.5

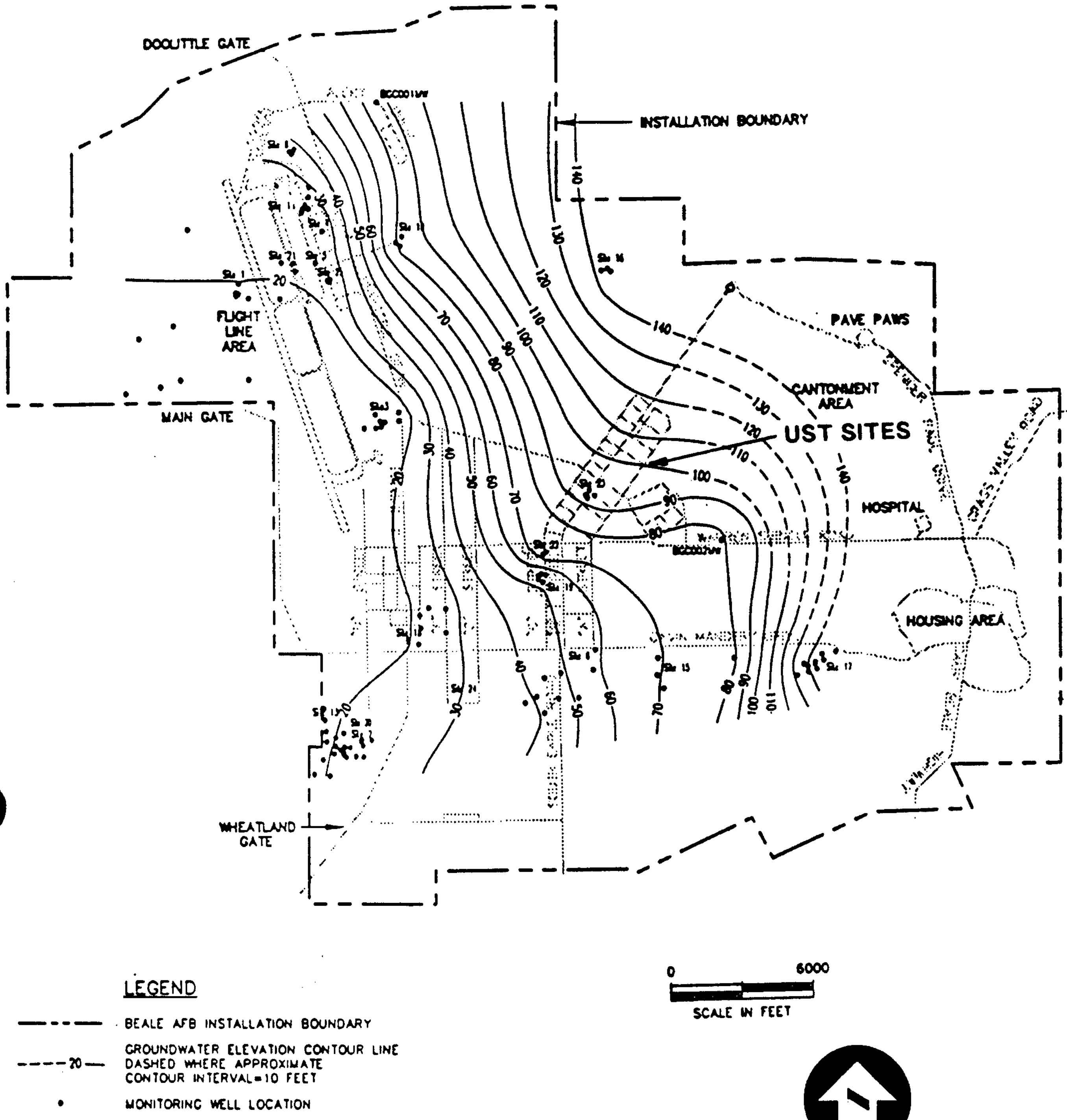
**SURFACE SOILS**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_P8.CDR 10/28/96




SOURCE: LAW, 1995 (GROUNDWATER LEVELS TAKEN 11/94)
MODIFIED FROM: SAC MASTER PLAN, BEALE AFB, MAY 1993

FIGURE 3.6

**BASEWIDE GROUNDWATER SURFACE ELEVATIONS**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_P8.CDR 10/28/96

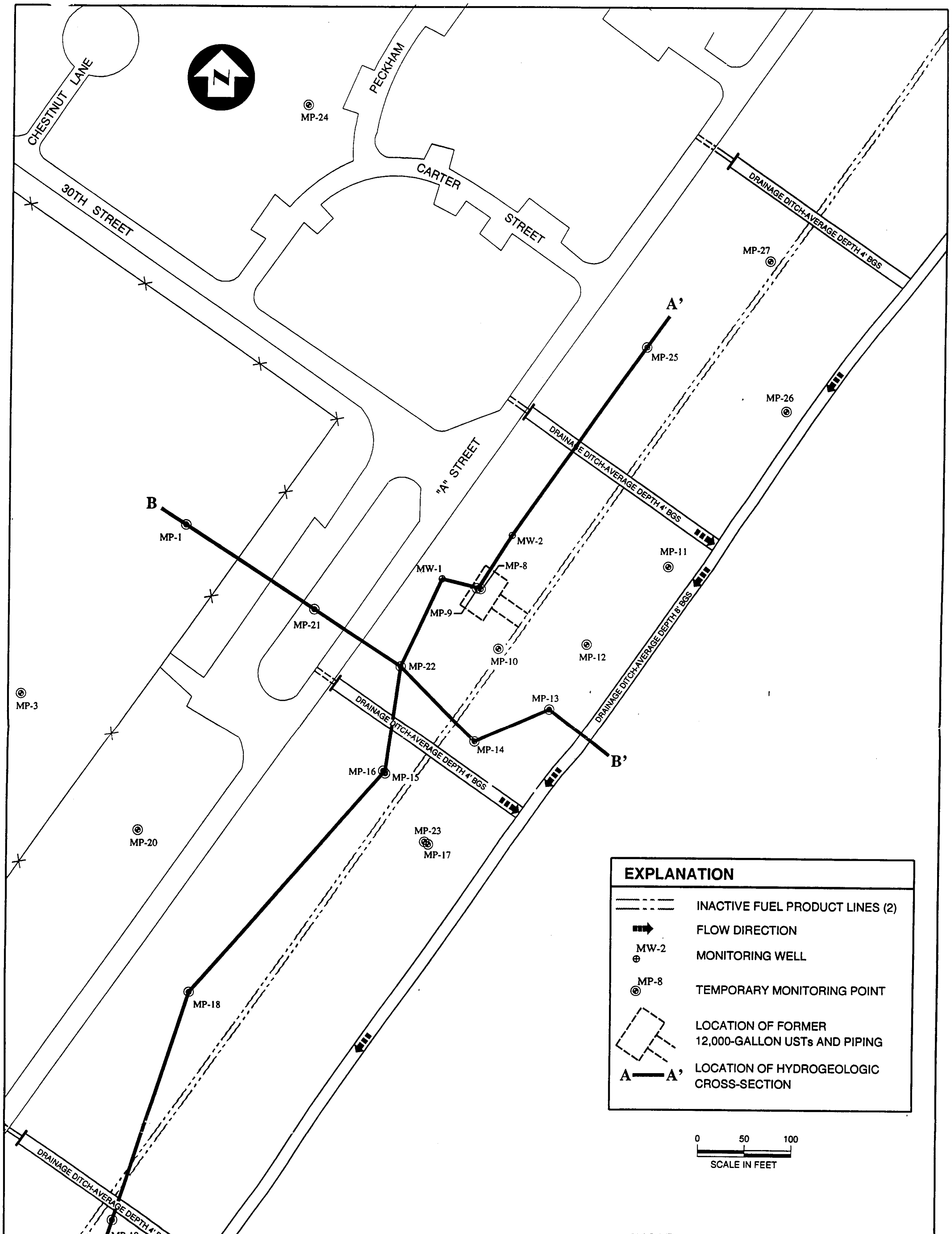



FIGURE 3.7

**LOCATIONS OF MONITORING WELLS, MONITORING POINTS, AND GEOLOGIC CROSS-SECTIONS**

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

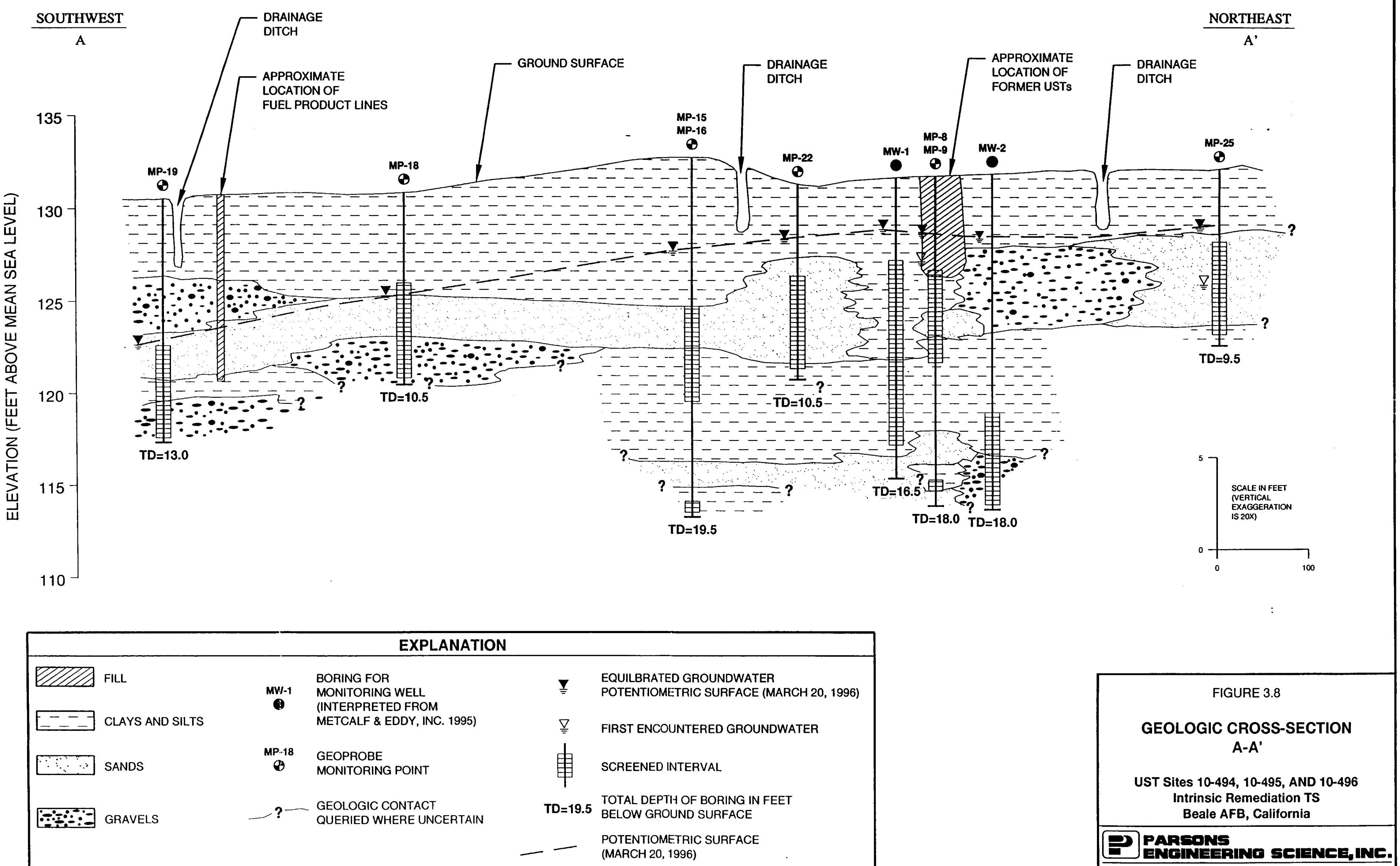



FIGURE 3.8

**GEOLOGIC CROSS-SECTION A-A'**

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

REV. 6 BE908-06.DWG 10/25/96

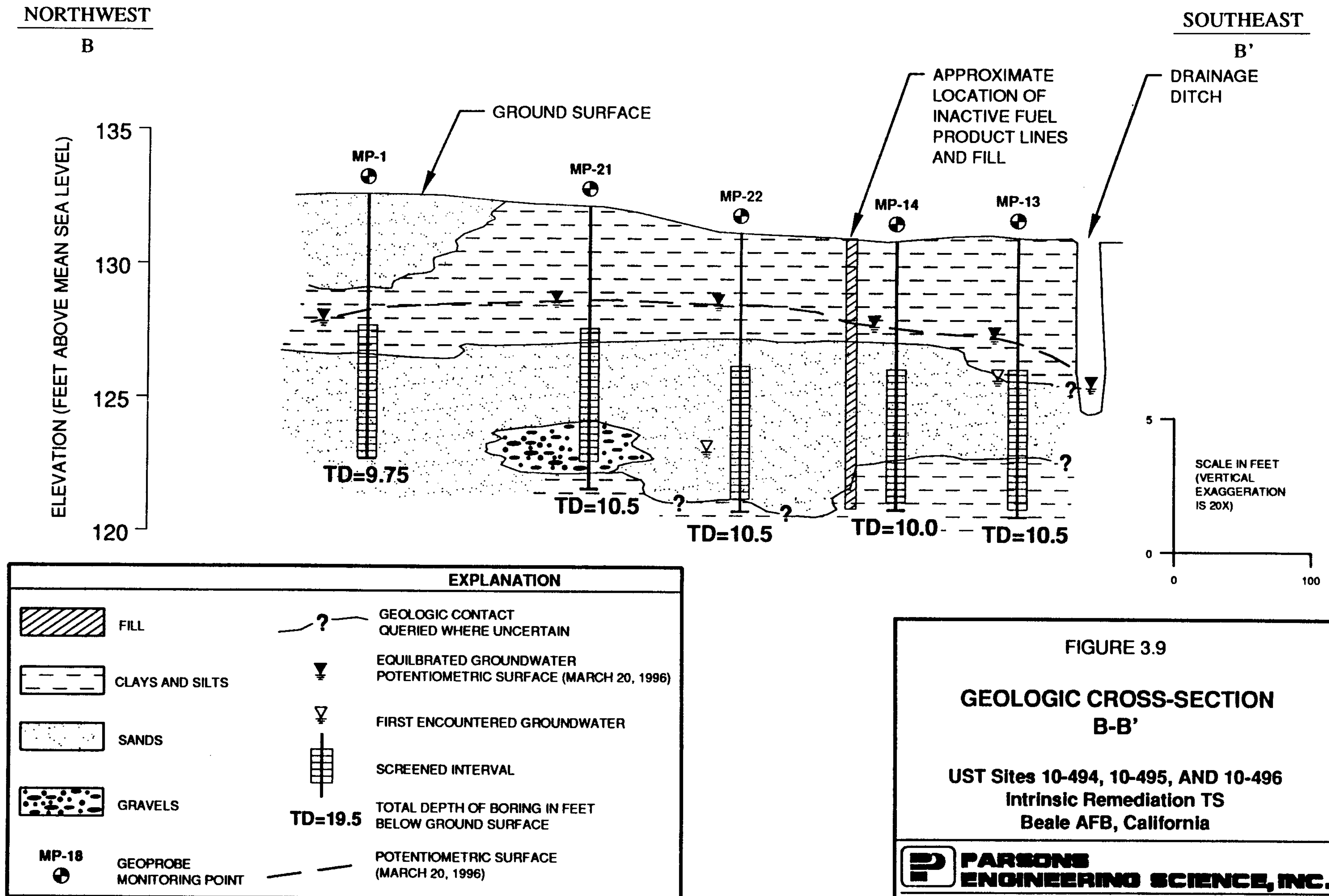



FIGURE 3.9

**GEOLOGIC CROSS-SECTION B-B'**

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

REV. 5 BE908-07.DWG 10/25/96

layer of sands and gravels was encountered beneath the layer of silty clay and clayey silt in some boreholes, but it is not known if this lower layer of sand and gravel is laterally continuous.

Soil samples collected and analyzed for grain-size distribution were consistent with the field geologist's interpretations. Soil samples were collected for grain-size distribution analysis from both the surficial gravelly and sandy clay and silt (at MP-24 at 3.0 feet bgs) and the underlying saturated coarse-grained unit (at MP-25 at 7.0 feet bgs). The following results were obtained: 5.5 % gravel, 31.5% sand, 6.0% silt, and 57.0% clay at MP-24; and 24.6% gravel, 59.8% sand, 1.0% silt, and 14.6% clay at MP-25.

Investigations indicate that the shallow soil units are generally flat-lying and laterally continuous across the site. The surface layer of sandy and gravelly silts and clays appears to act locally as an aquitard, confining the upper coarse-grained layer. The layer of silty clay to clayey silt underlying the coarse-grained sediments also may act as an aquitard, separating the upper and lower coarse-grained units.

At the southern end of the site, near MP-19, the upper and lower coarse-grained units may be connected. The coarse-grained units encountered in MP-19 are separated by a 1-foot thick layer of sandy, gravelly clay. However, the coarse-grained materials encountered in MP-19 may also be a thick section of the upper coarse-grained unit, with the silty clay to clayey silt layer underlying the coarse-grained unit at a depth greater than the depth of the borehole. The aquifer also appears to become unconfined at the southern end of the site near MP-18 and MP-19.

### 3.3.2 Groundwater Hydraulics

#### 3.3.2.1 Flow Direction and Gradient

The groundwater levels at the site varied from 123.43 to 131.26 feet above msl in March 1996, and 123.01 to 129.61 feet above msl in May 1996 (Table 3.2). These levels are about 20 to 30 feet higher than expected based on the regional groundwater potentiometric surface map (Figure 3.6). The shallow, coarse-grained, water-bearing unit encountered at the site may be a "perched" aquifer or the regional groundwater potentiometric surface map may simply be inaccurate near the UST Site because it is based on sparse data in the northeastern portion of the Base.

Groundwater is generally encountered first in the upper coarse-grained unit or at the unit's contact with the overlying silt and clay layer (Figures 3.8 and 3.9), but often rises to an equilibrated level at or above the contact between the upper coarse-grained layer and the overlying silt and clay. Groundwater levels measured in the MWs and MPs at the site were between 2.15 and 6.97 feet bgs in March 1996, and between 3.87 to 7.39 feet bgs in May 1996. A summary of historical groundwater measurements is presented in Table 3.2. A groundwater elevation/potentiometric surface map for the site for March 1996 is presented on Figure 3.10. This map is based on groundwater levels measured in MW-1 and the shallow MPs, and on the surface water levels measured in the large drainage channel in March 1996. Because the MWs at the site were installed in February 1995 and have not been sampled or

# TABLE 3.2
# SUMMARY OF HISTORICAL WATER LEVEL MEASUREMENTS
### UST Sites 10-494, 10-495, and 10-496
### Intrinsic Remediation TS
### Beale AFB, California

| Location | Date | Northing (ft) | Easting (ft) | Top of Casing Elevation (ft msl)[1] | Ground (ft msl) | Depth to Groundwater (ft btoc)[2] | Groundwater/Surface Water Potentiometric Surface (ft msl)[1] |
|---|---|---|---|---|---|---|---|
| MP-01 | Mar-96 | 530590.0 | 2174967.0 | 132.63 | 132.40 | 4.54 | 128.09 |
| | May-96 | | | | | 5.01 | 127.62 |
| MP-03 | Mar-96 | 530403.4 | 2174793.8 | 131.43 | 130.20 | 3.38 | 128.05 |
| | May-96 | | | | | 5.10 | 126.33 |
| MP-08 | Mar-96 | 530531.9 | 2175281.3 | n.a. | 131.80 | dry | - |
| MP-09 | Mar-96 | 530531.4 | 2175282.2 | 132.01 | 131.80 | 3.34 | 128.67 |
| | May-96 | | | | | 4.59 | 127.42 |
| MP-10 | Mar-96 | 530464.8 | 2175302.9 | 132.09 | 131.20 | 3.95 | 128.14 |
| | May-96 | | | | | 5.23 | 126.86 |
| MP-11 | Mar-96 | 530558.0 | 2175483.4 | 133.52 | 132.40 | 5.50 | 128.02 |
| | May-96 | | | | | 6.12 | 127.40 |
| MP-12 | Mar-96 | 530472.9 | 2175398.2 | 131.67 | 131.40 | 4.62 | 127.05 |
| | May-96 | | | | | 5.32 | 126.35 |
| MP-13 | Mar-96 | 530399.1 | 2175356.1 | 131.20 | 131.10 | 3.98 | 127.22 |
| | May-96 | | | | | 4.81 | 126.39 |
| MP-14 | Mar-96 | 530360.9 | 2175277.2 | 131.38 | 130.90 | 3.83 | 127.55 |
| | May-96 | | | | | 5.12 | 126.26 |
| MP-15 | Mar-96 | 530324.5 | 2175181.7 | 134.91 | 132.90 | 7.19 | 127.72 |
| | May-96 | | | | | 8.81 | 126.10 |
| MP-16 | Mar-96 | 530326.5 | 2175179.4 | n.a. | 132.90 | dry | - |
| MP-17 | Mar-96 | 530248.5 | 2175227.7 | 132.54 | 131.90 | 6.73 | 125.81 |
| | May-96 | | | | | 7.30 | 125.24 |
| MP-18 | Mar-96 | 530086.1 | 2174977.7 | 131.15 | 130.90 | 5.36 | 125.79 |
| | May-96 | | | | | 6.38 | 124.77 |
| MP-19 | Mar-96 | 529831.4 | 2174896.5 | 132.80 | 130.40 | 9.37 | 123.43 |
| | May-96 | | | | | 9.79 | 123.01 |
| MP-20 | Mar-96 | 530258.1 | 2174918.9 | 130.89 | 130.30 | 4.12 | 126.77 |
| | May-96 | | | | | 5.45 | 125.44 |
| MP-21 | Mar-96 | 530502.8 | 2175103.4 | 132.71 | 132.20 | 3.95 | 128.76 |
| | May-96 | | | | | 5.70 | 127.01 |
| MP-22 | Mar-96 | 530442.8 | 2175195.6 | 131.39 | 131.20 | 2.87 | 128.52 |
| | May-96 | | | | | 4.47 | 126.92 |
| MP-23 | Mar-96 | 530250.1 | 2175225.9 | n.a. | 131.90 | dry | - |

# TABLE 3.2 (continued)
## SUMMARY OF HISTORICAL WATER LEVEL MEASUREMENTS
### UST Sites 10-494, 10-495, and 10-496
### Intrinsic Remediation TS
### Beale AFB, California

| Location | Date | Northing (ft) | Easting (ft) | Top of Casing Elevation (ft msl)[1] | Ground (ft msl) | Depth to Groundwater (ft btoc)[2] | Groundwater/Surface Water Potentiometric Surface (ft msl)[1] |
|---|---|---|---|---|---|---|---|
| MP-24 | Mar-96 | 531049.9 | 2175090.2 | 134.92 | 134.30 | 3.66 | 131.26 |
| | May-96 | | | | | 5.91 | 129.01 |
| MP-25 | Mar-96 | 530793.0 | 2175457.6 | 133.12 | 132.20 | 3.86 | 129.26 |
| | May-96 | | | | | 4.85 | 128.27 |
| MP-26 | Mar-96 | 530727.5 | 2175607.0 | 132.86 | 131.80 | 4.88 | 127.98 |
| | May-96 | | | | | 5.24 | 127.62 |
| MP-27 | Mar-96 | 530886.9 | 2175596.8 | 133.10 | 132.90 | 3.81 | 129.29 |
| | May-96 | | | | | 4.49 | 128.61 |
| MW-01 | Feb-95 | 530539.3 | 2175241.9 | 131.65 | 131.80 | 5.35 | 126.30 |
| | Mar-96 | | | | | 2.42 | 129.23 |
| | May-96 | | | | | 4.12 | 127.53 |
| MW-02 | Feb-95 | 530588.3 | 2175316.3 | 131.81 | 131.90 | 5.31 | 126.50 |
| | Mar-96 | | | | | 3.36 | 128.45 |
| | May-96 | | | | | 4.86 | 126.95 |
| SW-01 | Mar-96 | 530265.1 | 2175312.8 | n.a. | 124.90 | n.a. | 124.90 |
| | May-96 | | | | | | 124.57 (est.) |
| SW-02 | Mar-96 | 530315.0 | 2175294.0 | n.a. | 127.30 | n.a. | 127.30 |
| | May-96 | | | | | | 126.97 (est.) |
| SW-03 | Mar-96 | 530308.0 | 2175344.0 | n.a. | 125.00 | n.a. | 125.00 |
| | May-96 | | | | | | 124.67 (est.) |

Notes

[1] ft msl - feet above mean sea level.

[2] ft btoc - feet below top of casing.

n.a. - not applicable

est. - estimated value

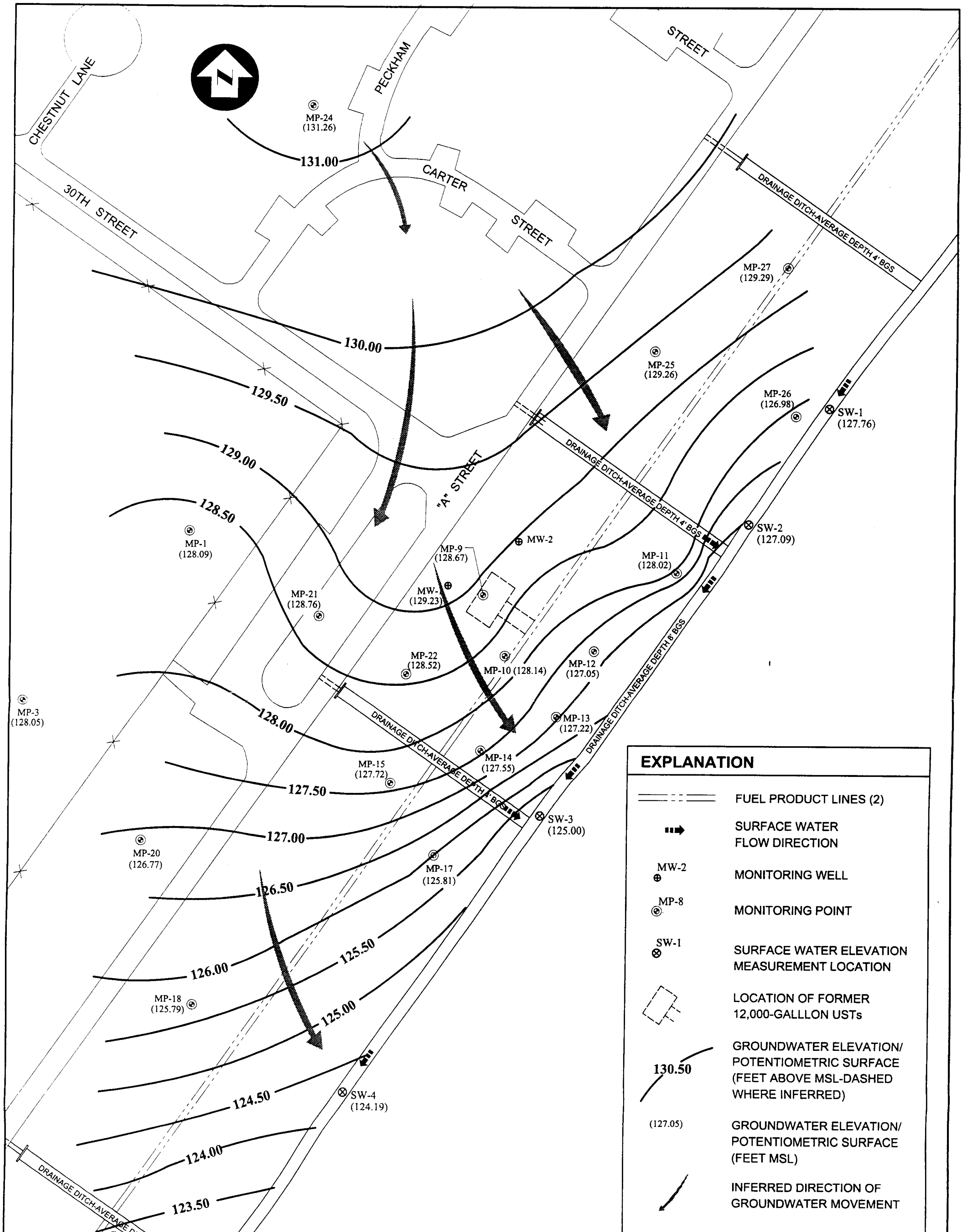



FIGURE 3.10

**GROUNDWATER ELEVATION/ POTENTIOMETRIC SURFACE MARCH 1996**

**UST Sites 10-494, 10-494, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
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monitored regularly since then, the magnitude of the seasonal variations in the groundwater levels at the site is not known.

The average gradient calculated from water levels in March 1996 was approximately 0.0097 foot per foot (ft/ft) toward the south-southeast in the vicinity of the site. The steepest gradient at the site, 0.029 ft/ft, was found in the vicinity of MP-14. A slight variation was noted in the groundwater flow direction and gradient between March and May 1996, with the flow taking a slightly more southerly direction, and the average gradient dropping to 0.0070 ft/ft. Somewhat higher variations are expected to exist between the wettest winter months and the driest summer months. Additional groundwater level measurements collected throughout the year would be required to determine seasonal variations in groundwater flow direction and gradient.

The groundwater flow direction and gradient appear to be significantly affected by the large drainage channel, which contains water year round and likely intersects the upper coarse-grained layer. Groundwater is assumed to discharge to this channel, based on the groundwater levels measured in the surrounding MPs and the surface water level measured in the channel. This interpretation is consistent with a general analysis by Strack (1989), who found that if a drainage ditch penetrates approximately 10 percent of an aquifer thickness, over 94 percent of the groundwater discharges into the ditch.

The shallower drainage ditches northeast and southwest of the site do not appear to intersect the upper water-bearing unit; however, water in these ditches may contribute to recharge of the unit. In March 1996, water was measured at 6 to 8 inches deep in the large channel and was flowing at a rate of approximately 1 foot per second (ft/s). In the shallow ditch southwest of the site, stagnant water was measured at 1 to 3 inches deep. No water was observed in the shallow northwest ditch.

It does not appear that the upper and lower coarse-grained units are hydrogeologically connected across most of the site. The groundwater level in MW-2 in May 1996 was lower than groundwater levels measured in MW-1, MP-9, and MP-11, yet the regional potentiometric surface map indicates that MW-2 would be upgradient or slightly cross-gradient from these locations if they were hydrogeologically connected. In addition, the deep MPs screened within the intervening clayey silt did not produce any groundwater, suggesting this layer acts as an aquitard or at least significantly restricts vertical groundwater movement. However, as discussed in Section 3.3.1, the two units may be connected at the southern end of the site near MP-19.

#### 3.3.2.2 Hydraulic Conductivity

Parsons ES estimated the hydraulic conductivity at wells MW-1 and MW-2 using both rising and falling head slug tests and the straight-line method of Bouwer and Rice (1976) and type-curve matching method of Cooper *et al.* (1967). The Bouwer and Rice method, although generally used for unconfined aquifers, can be used for confined conditions with limited accuracy (Bouwer, 1989).

The results of these slug tests are summarized in Table 3.3 and detailed in Appendix D. Input files and output files from the slug tests are provided in Appendix E. The average hydraulic conductivity obtained in rising head tests at MW-1, fully penetrating the upper water bearing unit, was 8.8 x $10^{-5}$ foot per second (ft/s) (2.7 x $10^{-3}$ centimeter per second [cm/s]). The average hydraulic conductivity obtained in rising and falling head tests at MW-2, partially penetrating the lower coarse-grained unit, was 6.7 x $10^{-5}$ ft/s (2.0 x $10^{-3}$ cm/s). These values are consistent with typical conductivities for silty sands to clean sands. The average hydraulic conductivity from the rising head tests conducted at MW-1 was used as the initial average hydraulic conductivity for the site in the groundwater model presented in Section 5.

The falling head test at MW-1 was not analyzed because of difficulties during the test. The slug was not in place at a discrete time, and water spilled over the top of the casing during placement of the slug.

#### 3.3.2.3 Effective Porosity

Because of the difficulty involved in accurately determining effective porosity, accepted literature values for the type of soil comprising the shallow saturated zone were used. Walton (1988) give ranges of effective porosity for gravelly and coarse sands of 0.20 to 0.35. Freeze and Cherry (1979) report ranges of effective porosities for sand of 0.25 to 0.50. Because the presence of silt tends to decrease the effective porosity, and because lower effective porosities result in higher computed advective groundwater velocities, an effective porosity of 0.25 was assumed for this project.

#### 3.3.2.4 Advective Groundwater Velocity

The advective velocity of groundwater in the direction parallel to groundwater flow is given by:

$$\bar{v} = \frac{K}{n_e}\frac{dH}{dL}$$

Where: $v$ = Average advective groundwater velocity (seepage velocity)

K = Hydraulic conductivity

$dH/dL$ = Gradient

$n_e$ = Effective porosity

Using this relationship in conjunction with site-specific data, the advective groundwater velocity at the site in March 1996 was estimated at approximately 80 to 120 feet per year (ft/year). Advective groundwater velocities are likely to be lower during the drier summer months, when the gradient would be expected to be lower.

#### 3.3.2.5 Preferential Flow Paths

The large drainage channel appears to exert significant influence on groundwater flow at the site. In addition. the shape of the groundwater potentiometric surface contours indicates that a more transmissive zone extends from the northwest (near MP-24), toward the former UST

# TABLE 3.3
# HYDRAULIC TESTING RESULTS
# MARCH 1996
## UST Sites 10-494, 10-495, and 10-496
## Intrinsic Remediation TS
## Beale AFB, California

| Location | Test Type | Analysis Method | Hydraulic Conductivity (ft/sec) |
|---|---|---|---|
| MW-1 | Slug Test, Rising Head #1 | Cooper-Bredehoeft-Papadopulos | 7.84E-05 |
| | Slug Test, Rising Head #2 | Cooper-Bredehoeft-Papadopulos | 9.75E-05 |
| MW-2 | Slug Test, Falling Head #1 | Bouwer and Rice | 9.09E-05 |
| | Slug Test, Rising Head #1 | Bouwer and Rice | 5.79E-05 |
| | Slug Test, Falling Head #2 | Bouwer and Rice | 6.11E-05 |
| | Slug Test, Rising Head #2 | Bouwer and Rice | 5.71E-05 |

location (near MW-1), and then southwest of the site (toward MP-15). This interpretation was supported by the model calibration results discussed in Section 5.

In addition, a filled excavation for the subsurface fuel pipelines that cross the site from northeast to southwest may potentially create a preferential flow path not observable on the sitewide groundwater potentiometric surface map. The depth of the back-filled excavation in the site vicinity is unknown, but could be as deep as 12 feet bgs. The nature of the fill is also unknown.

### 3.3.2 Groundwater Use

The closest wells used for domestic, industrial, and irrigation purposes are located 3 miles west of the site along the western boundary of the Base (CH2M Hill, 1991). These wells are screened in water-bearing zones between 125 to 360 feet bgs.

## 3.4 CLIMATE

Beale AFB experiences an interior Mediterranean climate characterized by hot, dry summers and cool, wet winters. Temperature extremes range from a low of 20 degrees Fahrenheit (°F) to a high of 113 °F. The Base receives approximately 95 percent of its annual precipitation between October and April. Total mean annual precipitation is 22.2 inches per year.

The annual evapotranspiration (ET) rate, 66.5 inches per year, coupled with the yearly precipitation yields a net precipitation of minus 44.3 inches per year. This implies that precipitation has little chance to percolate to regional groundwater. However, approximately 95 percent of the total rainfall occurs during the winter and spring months when ET rates are relatively low, so some recharge probably occurs on a seasonal basis.

# SECTION 4

# NATURE AND EXTENT OF CONTAMINATION AND SOIL, GROUNDWATER, AND SURFACE WATER CHEMISTRY

## 4.1 SOURCES OF CONTAMINATION

The primary sources of contamination at the UST Site were fuel leaks from the three former gasoline USTs. Although no spills or leaks have been documented, site investigations have identified fuel-related contamination in the soil and groundwater near the former UST location. All three tanks were reported to have been removed prior to 1962.

The excavation pit was left open after tank removal activities and was used as a compost pile for landscape waste until November 1995. In November 1995, the compost pile was removed, the excavation pit was filled with clean soil, and the site was completely regraded.

Two 4-inch diameter pipes used to supply the USTs until the end of World War II run through the site just east of the former UST location, parallel to A Street. These fuel pipelines are inactive but still in place. Although no spills or leaks have been documented, the product lines or distribution piping from the lines to the USTs could have been a source of contamination.

In December 1994, investigations by LAW (1995) identified hydrocarbon contamination at soil vapor points (SVPs) installed near the former USTs. In February 1995, soil and groundwater investigations by Metcalf & Eddy (1995) also identified hydrocarbon contamination in soil boring and test pit samples located around the excavation pit.

Two monitoring wells, MW-1 and MW-2, were installed near the excavation pit. Although hydrocarbon contamination was not detected in groundwater samples from these wells, groundwater samples from three test pits (TP-8, TP-9, and TP-12) and one soil boring (SB-3) showed hydrocarbon contamination.

A more detailed description of past investigations is outlined in the work plan for the TS (Parsons ES, 1995). A summary of the soil and groundwater sampling results from prior investigations and this investigation is presented in the following sections. Analytical results from previous investigations are summarized in Appendix B.

## 4.2 SOURCE AND SOIL CHEMISTRY

### 4.2.1 Mobile LNAPL Contamination

Mobile LNAPL is defined as LNAPL that is free to flow in the aquifer and that will flow from the aquifer matrix into a well under the influence of gravity. Mobile LNAPL may be present in the shallow groundwater (3 to 6 feet bgs), as evidenced by visual indications of free product during drilling of SB-6 and soil vapor points 132 and 142 in February 1995 (Metcalf & Eddy, 1995). However, no mobile LNAPL was encountered during soil, groundwater, or surface water sampling performed by Parsons ES personnel in March 1996; therefore, any mobile LNAPL at the site is likely to be very limited in extent.

In addition, the low concentrations of dissolved BTEX in groundwater at the site (discussed in Section 4.3) suggest that any mobile LNAPL that may be present is likely to be highly weathered, probably due to the age of the fuel releases.

### 4.2.2 Residual LNAPL Contamination

Residual LNAPL is defined as the LNAPL that is trapped in the aquifer by the processes of cohesion and capillarity, and therefore will not flow within the aquifer and will not flow from the aquifer matrix into a well under the influence of gravity. At this site, any residual LNAPL consists of fuel hydrocarbons primarily derived from gasoline.

Petroleum contamination was detected at low concentrations in several soil samples collected at the site (Section 4.2.3); however, the majority of detected soil contamination is believed to have been derived from the sorption of contaminants in the groundwater to soil because most soil samples were collected near the capillary fringe or in the saturated zone due to the high groundwater levels encountered at the site. In all cases, the residual soil contamination appeared to be highly weathered. The maximum concentrations of TPH and BTEX in soil, 780 mg/kg and 2.2 mg/kg, respectively, were measured in the sample collected at MP-10 at 5.5 feet bgs in the unsaturated zone. This sample was collected just outside the excavation pit boundary at a depth corresponding with the bottom of the former USTs. This was the only MP where field observations indicated that soil contamination was in the vadose zone, suggesting that residual contamination in the vadose zone is limited to the fringes of the excavation boundary. Previous site investigation soil and soil gas sampling results also indicated that residual soil contamination is probably limited to just outside the excavation pit boundary.

### 4.2.3 Soil and Soil Gas BTEX and Fuel Hydrocarbon Contamination

Soil samples were collected for lithologic description and organic and inorganic analyses at the UST Site in February 1995 (Metcalf & Eddy, 1995) and during this investigation in February/March 1996. In addition, soil vapor screening was conducted in December 1994 (LAW, 1995). The soil and soil vapor sampling analytical data from the prior investigations are included in Appendix B.

During the soil vapor survey conducted in December 1994, soil vapor samples were collected from a total of seven soil vapor points (SVPs) (132, 133, 134, and 142 through 145) at depths

between 5 and 8 feet bgs. Sampling locations are shown on Figure 2.1. Soil vapor samples were analyzed for total petroleum hydrocarbons (TPH) by EPA Method SW8015 (modified), BTEX by EPA Method SW8020, and halogenated volatile organic compounds (VOCs) by EPA Method SW8010. The maximum detected concentrations were 27,120 parts per million by volume (ppmv) TPH, 87.66 ppmv benzene, and 132.45 ppmv total BTEX, measured at SVP 132, located near MW-2 and north of the excavation pit. The highest detections from the soil vapor survey were generally in soils nearest to and downgradient from the UST excavation pit. No halogenated VOCs were detected in any soil vapor sample.

During a subsequent site investigation in February 1995, soil samples were collected from seven soil boreholes (SB-1 through SB-7) and one test pit (TP-10). Soil samples were analyzed for TPH as gasoline (TPH-g); TPH as diesel (TPH-d); BTEX; and total lead. The maximum detected concentrations were 180 milligrams per kilogram (mg/kg) TPH-g (SB-4 at 5.5 feet bgs) and 25 mg/kg TPH-d (SB-6 at 5.5 feet bgs). SB-4 and SB-6 are both located just outside and downgradient from the former excavation pit (Figure 2.1). No BTEX compounds were detected in soil samples. Total lead concentrations did not exceed the background soil concentration range of 17 to 35 mg/kg used at Beale AFB (LAW, 1995).

Eleven soil samples were collected in February/March 1996 by Parsons ES personnel during investigation activities for this study. Soil sample depths ranged from 4.0 to 9.5 feet bgs. Samples were analyzed for TPH (quantified as gasoline, diesel, jet fuel, and motor oil), BTEX, and the trimethylbenzene (TMB) isomers. Soil analytical results are summarized in Table 4.1. TPH concentrations ranged from below detection limits to a maximum of 780 mg/kg TPH-g at MP-10. The laboratory reported most TPH quantitations as not matching the calibration standard and/or heavier than the standard, probably due to the highly weathered nature of the residual contamination. BTEX concentrations ranged from below detection limits to 2.2 mg/kg (consisting entirely of xylenes) at MP-10. Benzene, toluene, and ethylbenzene were not detected in any soil samples.

### 4.2.4 Total Organic Carbon

TOC concentrations are used to estimate the amount of organic matter sorbed on soil particles or trapped in the interstitial passages of a soil matrix. The TOC concentration in the saturated zone is an important parameter used to estimate the amount of contaminant that could potentially be sorbed to the aquifer matrix. Sorption results in retardation of the contaminant plume relative to the average advective groundwater velocity.

During this investigation, three soil samples collected from the saturated zone were analyzed for TOC (MP-19, MP-24, and MP-25). All locations were outside the area of contamination. The TOC concentrations ranged from 90 mg/kg to 2,200 mg/kg.

## 4.3 GROUNDWATER AND SURFACE WATER CHEMISTRY

### 4.3.1 Fuel Hydrocarbon Contamination

Laboratory analytical results from sampling conducted as part of this TS investigation confirmed the presence of fuel hydrocarbon contamination dissolved in the shallow groundwater at the UST Site. Total dissolved BTEX was detected in groundwater samples

# TABLE 4.1
# FUEL HYDROCARBON COMPOUNDS DETECTED IN SOIL SAMPLES
## MARCH 1996
### UST Sites 10-494, 10-495, and 10-496
### Intrinsic Remediation TS
### Beale AFB, California

| | Analyses: | Total Petroleum Hydrocarbons | | | | BTEX | | | | | Other Volatile Aromatics | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Method: | USEPA SW8015M | | | | USEPA SW5030/SW8020A | | | | | | | | |
| | Analyte: | TPH-g | TPH-JP5 | TPH-d | TPH-mo | Benzene | Toluene | Ethyl-benzene | Total Xylenes | Total BTEX | 1,2,3-TMB | 1,2,4-TMB | 1,3,5-TMB | Total TMB |
| Location | Depth (ft bgs) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| MP-01 | 5.0 | <1.1 | <1.1 | 4.4 YH | 51 | <0.0057 | <0.0057 | <0.0057 | <0.0114 | <0.029 | <0.0057 | <0.0057 | <0.0057 | <0.017 |
| MP-09 | 6.0 | <1.2 | 2.3 | 8.8 YH | 15 YL | <0.0058 | <0.0058 | <0.0058 | <0.0116 | <0.029 | <0.0058 | <0.0058 | <0.0058 | <0.017 |
| MP-10 | 5.5 | 780 YH | 110 Y | 120 Y | <5.6 | <0.110 | <0.110 | <0.110 | 2.2 | 2.2 | <0.11 | 0.18 | <0.11 | 0.18 |
| MP-11 | 7.0 | 40 YH | 5.5 YH | 10 Y | <5.7 | <0.014 | <0.014 | <0.014 | 0.16 | 0.16 | 0.11 | 0.085 | 0.016 | 0.21 |
| MP-12 | 4.0 | <1.2 | <1.2 | <1.2 | <6 | <0.006 | <0.006 | <0.006 | <0.012 | <0.030 | <0.006 | <0.006 | <0.006 | <0.018 |
| MP-13 | 6.5 | <1.2 | 7 Y | 4.7 YL | <5.8 | <0.0058 | <0.0058 | <0.0058 | <0.0116 | <0.029 | <0.0058 | <0.0058 | <0.0058 | <0.017 |
| MP-14 | 7.0 | 21 Y | 55 Y | 33 YL | 21 YL | <0.0059 | <0.0059 | <0.0059 | 0.081 | 0.081 | 0.12 | 0.16 | 0.13 | 0.41 |
| MP-15 | 9.5 | 22 Y | 73 Y | 110 Y | <5.6 | <0.0056 | <0.0056 | <0.0056 | 0.086 | 0.086 | 0.19 | <0.0056 | 0.090 | 0.28 |
| MP-19 | 7.0 | <1.1 | 1.3 Z | 1.3 Z | <5.5 | <0.0055 | <0.0055 | <0.0055 | <0.011 | <0.028 | <0.0055 | <0.0055 | <0.0055 | <0.017 |
| MP-22 | 7.0 | 44 YH | 340 YH | 500 YL | 23 YL | <0.016 | <0.016 | <0.016 | 0.15 | 0.15 | 0.078 | 0.070 | 0.036 | 0.18 |
| MP-23 | 6.5 | <1.1 | 1.9 Z | <1.1 | <5.7 | <0.0057 | <0.0057 | <0.0057 | <0.0114 | <0.029 | <0.0057 | <0.0057 | <0.0057 | <0.017 |
| | 7.0 | <1.1 | <1.1 | <1.1 | <5.7 | <0.0057 | <0.0057 | <0.0057 | <0.0114 | <0.029 | <0.0057 | <0.0057 | <0.0057 | <0.017 |

**Notes:**

| | |
|---|---|
| <0.5 | : Not detected at indicated concentration. |
| H | : heavier hydrocarbons than indicated in standard |
| L | : lighter hydrocarbons than indicated in standard |
| Y | : sample exhibits fuel pattern which does not resemble standard |
| Z | : sample exhibits unknown single peak or peaks |

TPH-g: Total petroleum hydrocarbons as gasoline
TPH-JP5: Total petroleum hydrocarbons as jet fuel #5
TPH-d: Total petroleum hydrocarbons as diesel
TPH-mo: Total petroleum hydrocarbons as motor oil

from 6 of the 20 sampling locations at concentrations ranging from 0.6 micrograms per liter (μg/L) (MP-19) to 71.9 μg/L (MP-13). Table 4.2 summarizes groundwater analytical results from the March 1996 sampling. No mobile LNAPL was found.

BTEX was not detected in any of the three surface water samples collected. No sheens, odors, or other evidence of contamination was noted along the drainage channel or in the drainage ditch during sampling. However, 0.14 mg/L TPH-d was detected in the surface water sample collected from the small drainage ditch southwest of the site (sample location SW-02 on Figure 2.1). As discussed in Section 3.3.2.1, the surface water in the shallow drainage ditch is unlikely to be a discharge point for the shallow groundwater. Therefore, the low detection of TPH-d may be from surface runoff from the civil engineering support yard, which is located west of the site and upstream from this drainage ditch.

The TPH-g and BTEX concentrations measured in groundwater in March 1996 generally agree with previous sampling conducted in February 1995 (Appendix B). BTEX and TPH-g isopleths are shown on Figures 4.1 and 4.2. TMB concentrations are presented in Table 4.2. TMB results are presented because they are water-soluble fuel constituents that can be recalcitrant to biological degradation under anaerobic conditions; therefore, they can be used as tracer compounds in the calculation of anaerobic decay rates. Analytical results from the March 1996 investigation are discussed in the following subsections.

#### 4.3.1.1 BTEX

The areal distribution of total dissolved BTEX in groundwater for the March 1996 TS is presented on Figure 4.1. As indicated by the 10-μg/L isopleth, the areal extent of the BTEX plume is estimated to be approximately 220 feet long and 180 feet wide and is elongated parallel to the direction of groundwater flow. The plume extends to the large drainage channel, which flows northeast to southwest, southeast of the former UST locations.

Because the plume has likely existed for a relatively long time period (more than 30 years), the plume has likely reached its maximum extent (i.e., the plume is no longer expanding). The maximum concentrations of BTEX were detected at MP-13 (71.1 μg/L) and MP-14 (71.9 μg/L), approximately 100 feet downgradient from the presumed source near the excavation pit. Although site access problems prevented installation of MPs to the southeast of the large drainage channel, the groundwater potentiometric surface map suggests that during the March 1996 sampling event the drainage channel was a discharge point for the shallow groundwater (see Section 3.3.2.1). Based on the March 1996 groundwater data, groundwater contaminants are not likely to underflow the channel; however, additional sampling east of the drainage channel and during the drier summer season would be required to confirm this conclusion.

Benzene was only detected at MP-14 at a concentration of 9.1 μg/L. This benzene concentration exceeds the California maximum contaminant level (MCL) for benzene of 1 μg/L (California Code of Regulations, Title 22). MP-14 is downgradient of the source area; however, the relatively low BTEX concentrations and the short length of the plume prevents a determination of trends in benzene concentration in comparison to total BTEX with increasing distance from the source area.

**TABLE 4.2**

# FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUNDWATER/SURFACE WATER

## MARCH 1996

### UST Sites 10-494, 10-495, and 10-496
### Intrinsic Remediation TS
### Beale AFB, California

| Analyses: | Total Petroleum Hydrocarbons | | | | BTEX | | | | | Other Volatile Aromatics | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method: | USEPA SW8015M | | | | USEPA SW5030/SW8020A | | | | | | | | |
| Analyte: | TPH-g | TPH-JP5 | TPH-d | TPH-mo | Benzene | Toluene | Ethyl-benzene | Total Xylenes | Total BTEX | 1,2,3-TMB | 1,2,4-TMB | 1,3,5-TMB | Total TMB |
| Location | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (µg/L) | (µg/L) | (µg/L) | (µg/L) | (µg/L) | (µg/L) | (µg/L) | (µg/L) | (µg/L) |
| MP-03 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-09 | <0.050 | 0.71 YH | 4.5 YH | 3.5 Y | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| (dup) | (<0.050) | (0.70 YH) | (4.5 YH) | (3.8 Y) | (<0.5) | (<0.5) | (<0.5) | (<0.5) | (<2.0) | (<0.5) | (<0.5) | (<0.5) | (<1.5) |
| MP-10 | 1.4 | 1.5 YH | 4.3 YLH | 2.2 YL | <0.5 | <0.5 | 20 | 21.9 | 41.9 | <0.5 | 3.6 | 7.8 | 11.4 |
| MP-11 | 0.38 Y | 0.13 Y | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| (dup) | (0.41 Y) | (0.19 Y) | (0. 094 YL) | (<0.30) | (<0.5) | (<0.5) | (<0.5) | (<0.5) | (<2.0) | (1.4) | (<0.5) | (<0.5) | (1.4) |
| MP-12 | <0.005 | n.a. | n.a. | n.a. | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-13 | 5.9 | 2.2 YH | 3.5 YHL | 1.6 YL | <2.5 | 9.2 | 22 | 39.9 | 71.1 | 120 | <2.5 | 59 | 179 |
| MP-14 | 4.0 | 1.9 YL | 2.2 YL | 0.31 YL | 9.1 | 30 | 10 | 22.8 | 71.9 | 24 | 24 | 36 | 84 |
| MP-15 | 0.13 Y | n.a. | n.a. | n.a. | <0.5 | 0.6 | 0.7 | 0.8 | 2.1 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-17 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-18 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-19 | <0.050 | n.a. | n.a. | n.a. | <0.5 | 0.6 | <0.5 | <0.5 | 0.6 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-20 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-21 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-22 | 0.77 Y | 0.34 Y | 0.32 Y | <0.30 | <0.5 | <0.5 | <0.5 | 2.2 | 2.2 | <0.5 | <0.5 | <0.5 | <1.5 |
| (dup) | (0.79 Y) | (n.a.) | (n.a.) | (n.a.) | (<0.5) | (<0.5) | (1.8) | (<0.5) | (1.8) | (<0.5) | (<0.5) | (2.2) | (2.2) |
| MP-24 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-25 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-26 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MP-27 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MW-01 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| MW-02 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| SW-01 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| SW-02 | <0.050 | <0.050 | 0.140 Y | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |
| (dup) | (<0.050) | (<0.050) | (0.120 Y) | (<0.30) | (<0.5) | (<0.5) | (<0.5) | (<0.5) | (<2.0) | (<0.5) | (<0.5) | (<0.5) | (<1.5) |
| SW-03 | <0.050 | <0.050 | <0.050 | <0.30 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <0.5 | <0.5 | <0.5 | <1.5 |

**Notes:**

<0.5 : Not detected above given concentration.
n.a. : Not analyzed.
(dup) : Primary analysis results followed in parentheses by duplicate analysis results.

H : heavier hydrocarbons than indicated in standard
L : lighter hydrocarbons than indicated in standard
Y : sample exhibits fuel pattern which does not resemble standard

\722450\14\REPORT\FINAL\TABLES.XLS

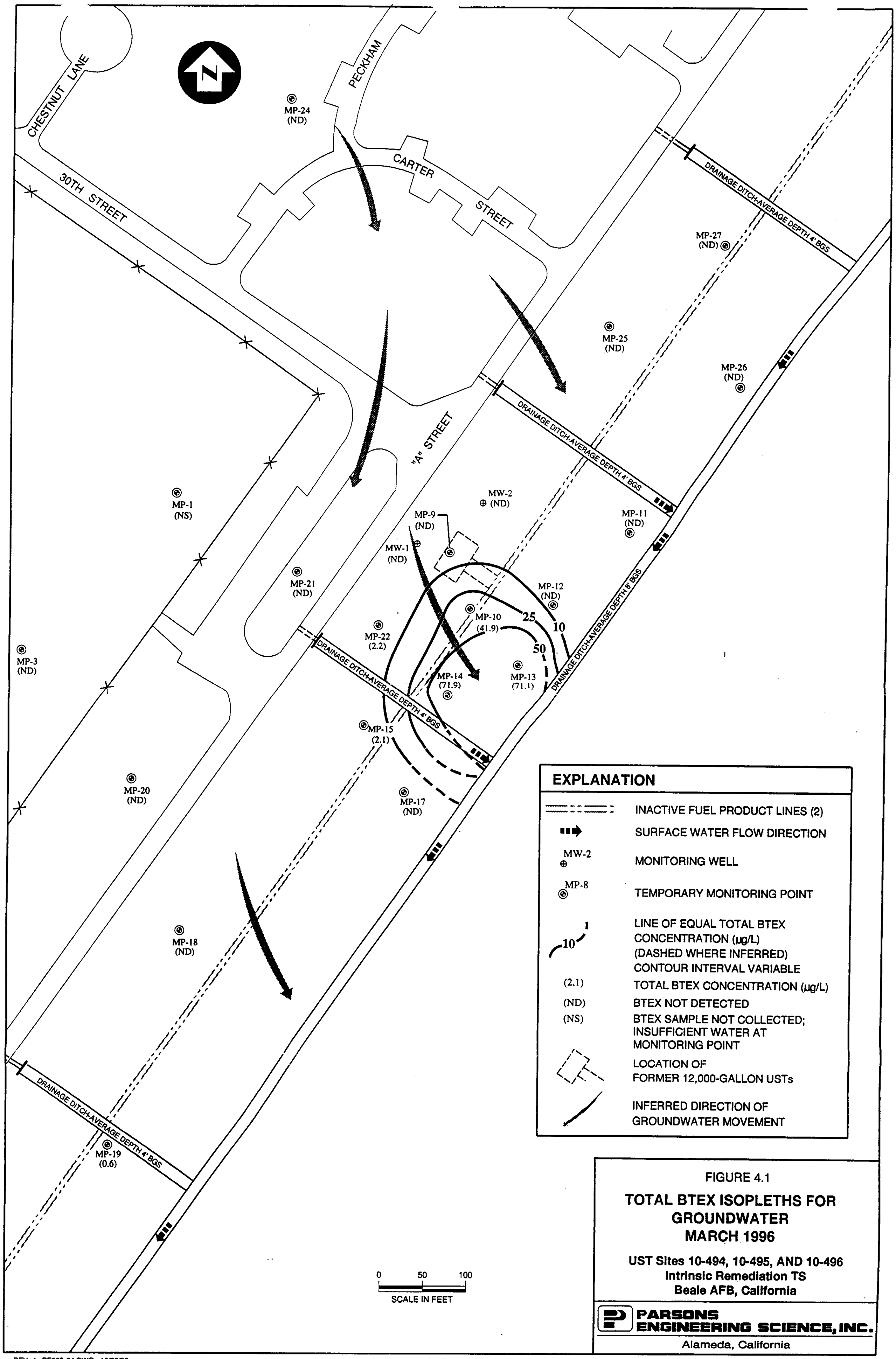


FIGURE 4.1

**TOTAL BTEX ISOPLETHS FOR GROUNDWATER MARCH 1996**

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

REV. 4 BE907-04.DWG 10/22/96

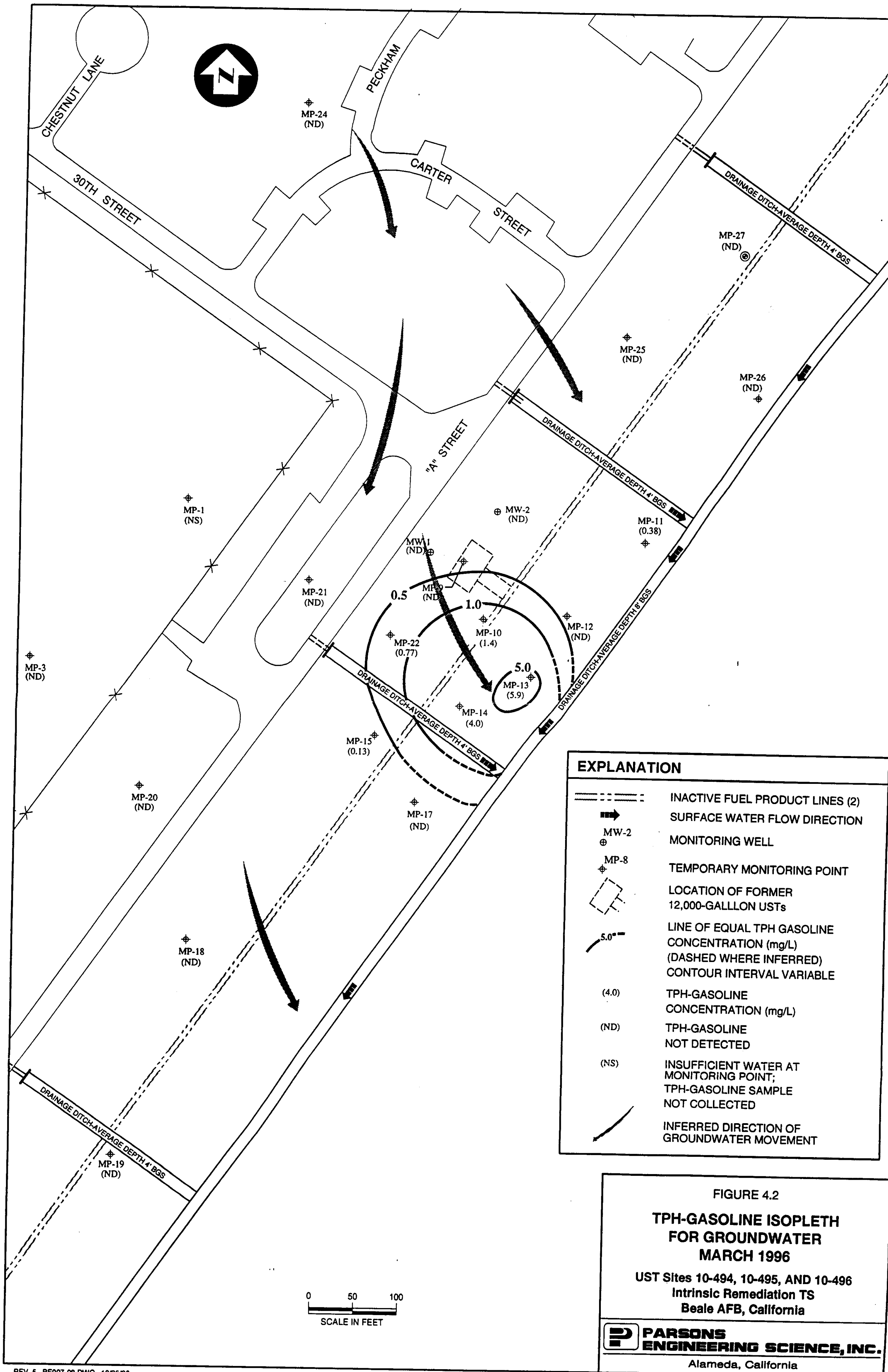


FIGURE 4.2

**TPH-GASOLINE ISOPLETH FOR GROUNDWATER MARCH 1996**

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

Dissolved toluene, ethylbenzene, and total xylenes concentrations did not exceed their California MCLs of 150 µg/L, 750 µg/L, and 1,750 µg/L, respectively, at any sampled location. Total xylene concentrations exceeded the taste and odor threshold of 17 µg/L at locations downgradient of the source area (MP-10, MP-13, and MP-14); toluene and ethylbenzene concentrations did not exceed their taste and odor thresholds at any location. Although toluene was detected slightly above the detection limit at MP-19 (0.6 µg/L), this detection appears to be unrelated to the plume at the UST Site based on data from the other MPs.

Because the plume extends to the large drainage channel, and as discussed in Section 3.3.2.1, this drainage channel is probably the point of groundwater discharge to surface water, the surface water historically may have received some mass of fuel-related contaminants from the site. An estimate of the BTEX mass released into the channel is made in Section 5.6 based on results of the calibrated groundwater model. The current lack of detectable concentrations of BTEX in surface water samples collected during this study indicates that the current rate of mass discharge into the surface water is low relative to the rate of natural attenuation of these chemicals in the channel and the volume of water flowing in the channel.

#### 4.3.1.2 Total Petroleum Hydrocarbons

The areal distributions of TPH-g in groundwater for the TS sampling in March 1996 is presented on Figure 4.2. The shape of the TPH-g plume is nearly identical to that of the BTEX plume. Detected concentrations of TPH-g ranged from 0.13 mg/L at MP-15 to 5.9 mg/L at MP-13 (Table 4.2). TPH-g concentrations exceeded the taste and odor threshold at several locations downgradient and crossgradient of the source area (Table 4.2 and Figure 4.2). As with the soil analytical results, the laboratory reported some TPH quantitations as not matching the calibration standard, probably due to the highly weathered nature of the contamination. Detected TPH-g concentrations were generally greater than other TPH quantitations and less likely to be reported by the laboratory as not matching the calibration standard. These data are consistent with the historical evidence that gasoline was the fuel stored in (and released from) the USTs at the site.

#### 4.3.1.3 Other Volatile Aromatics

The TMB isomers also were detected in MPs where BTEX and TPH-g were detected. TMBs are water-soluble fuel constituent and are used as tracers to estimate anaerobic decay rates for BTEX. The TMB results are discussed more fully in conjunction with the calculation of anaerobic decay rates (Section 5.3.5).

### 4.3.2 Inorganic Chemistry and Geochemical Indicators of BTEX Biodegradation

Microorganisms obtain energy for cell production and maintenance by facilitating thermodynamically advantageous redox reactions involving the transfer of electrons from electron donors to available electron acceptors. This results in the oxidation of the electron donor and the reduction of the electron acceptor. Electron donors at the UST Site are natural organic carbon and fuel hydrocarbon compounds. Fuel hydrocarbons are completely

degraded or detoxified if they are utilized as the primary electron donor for microbial metabolism (Bouwer, 1992). Electron acceptors are elements or compounds that occur in relatively oxidized states, and may include oxygen, nitrate, ferric iron, sulfate, and carbon dioxide.

The driving force of BTEX degradation is electron transfer, which is quantified by the Gibbs free energy of the reaction ($\Delta G°_r$) (Stumm and Morgan, 1981; Bouwer, 1994; Godsey, 1994). The value of $\Delta G°_r$ represents the quantity of free energy consumed or yielded to the system during the reaction. Table 4.3 lists stoichiometry of the redox equations involving BTEX and the resulting $\Delta G°_r$. Although thermodynamically favorable, most of the reactions involved in BTEX oxidation cannot proceed abiotically because of the lack of activation energy. Microorganisms are capable of providing the necessary activation energy; however, they will facilitate only those redox reactions that have a net yield of energy (i.e., $\Delta G°_r < 0$).

Microorganisms preferentially utilize electron acceptors while metabolizing fuel hydrocarbons (Bouwer, 1992). DO is utilized first as the prime electron acceptor. After the DO is consumed, fuel-degrading anaerobic microorganisms typically use electron acceptors in the following order of preference: nitrate, ferric iron hydroxide, sulfate, and finally carbon dioxide.

Depending on the types and concentrations of electron acceptors present (e.g., nitrate, iron, sulfate, and carbon dioxide), pH conditions, and redox potential, anaerobic biodegradation can occur by denitrification, ferric iron reduction, sulfate reduction, or methanogenesis. Other, less common anaerobic degradation mechanisms such as manganese or nitrate reduction may dominate if the physical and chemical conditions in the subsurface favor use of these electron acceptors. Anaerobic destruction of the BTEX compounds is associated with the accumulation of fatty acids, production of methane, solubilization of iron, and reduction of nitrate and sulfate (Cozzarelli *et al.*, 1990; Wilson *et al.*, 1990). Environmental conditions and microbial competition ultimately determine which processes will dominate. Vroblesky and Chapelle (1994) show that the dominant terminal electron accepting process can vary both temporally and spatially in an aquifer with fuel hydrocarbon contamination.

Site groundwater data for electron acceptors strongly suggest that natural attenuation of hydrocarbons in the aquifer is occurring, and that aerobic biodegradation, denitrification, and iron reduction are the primary mechanisms through which remediation of the hydrocarbons in the aquifer is occurring. Geochemical parameters for site groundwater are discussed in the following sections.

#### 4.3.2.1 Dissolved Oxygen

DO concentrations were measured at MWs and MPs during groundwater sampling in March 1996. Concentrations ranged from 0.15 to 8.40 mg/L. Table 4.4 lists the measured DO concentrations. Figure 4.3 is an isopleth map showing the distribution of DO concentrations in groundwater. Although comparison of Figures 4.1 and 4.3 shows graphically that areas with elevated total BTEX concentrations generally correlate with areas with depleted DO concentrations, the depleted DO concentrations may also be attributable to the former compost pile at the site. Therefore, DO may not have been an important electron acceptor at

## TABLE 4.3

## COUPLED OXIDATION REACTIONS FOR BTEX COMPOUNDS
## UST SITES 10-494, 10-495, AND 10-496
## INTRINSIC REMEDIATION TS
## BEALE AIR FORCE BASE, CALIFORNIA

| Coupled Benzene Oxidation Reactions | $\Delta G°_r$ (kcal/mole Benzene) | $\Delta G°_r$ (kJ/mole Benzene) | Stoichiometric Mass Ratio of Electron Acceptor to Compound |
|---|---|---|---|
| $7.5O_2 + C_6H_6 \Rightarrow 6CO_{2,g} + 3H_2O$<br>*Benzene oxidation /aerobic respiration* | -765.34 | -3202 | 3.07:1 |
| $6NO_3^- + 6H^+ + C_6H_6 \Rightarrow 6CO_{2,g} + 6H_2O + 3N_{2,g}$<br>*Benzene oxidation / denitrification* | -775.75 | -3245 | 4.77:1 |
| $60H^+ + 30\underline{Fe(OH)_{3,a}} + C_6H_6 \Rightarrow 6CO_2 + 30Fe^{2+} + 78H_2O$<br>*Benzene oxidation / iron reduction* | -560.10 | -2343 | 21.5:1[a] |
| $7.5H^+ + 3.75SO_4^{2-} + C_6H_6 \Rightarrow 6CO_{2,g} + 3.75H_2S^o + 3H_2O$<br>*Benzene oxidation / sulfate reduction* | -122.93 | -514.3 | 4.61:1 |
| $4.5H_2O + C_6H_6 \Rightarrow 2.25CO_{2,g} + 3.75CH_4$<br>*Benzene oxidation / methanogenesis* | -32.40 | -135.6 | 0.77:1 [b] |

| Coupled Toluene Oxidation Reactions | $\Delta G°_r$ (kcal/mole Toluene) | $\Delta G°_r$ (kJ/mole Toluene) | Stoichiometric Mass Ratio of Electron Acceptor to Compound |
|---|---|---|---|
| $9O_2 + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4H_2O$<br>*Toluene oxidation /aerobic respiration* | -913.76 | -3823 | 3.13:1 |
| $7.2NO_3^- + 7.2H^+ + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 7.6H_2O + 3.6N_{2,g}$<br>*Toluene oxidation / denitrification* | -926.31 | -3875 | 4.85:1 |
| $72H^+ + 36\underline{Fe(OH)_{3,a}} + C_6H_5CH_3 \Rightarrow 7CO_2 + 36Fe^{2+} + 94H_2O$<br>*Toluene oxidation / iron reduction* | -667.21 | -2792 | 21.86:1[a] |
| $9H^+ + 4.5SO_4^{2-} + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4.5H_2S^o + 4H_2O$<br>*Toluene oxidation / sulfate reduction* | -142.86 | -597.7 | 4.7:1 |
| $5H_2O + C_6H_5CH_3 \Rightarrow 2.5CO_{2,g} + 4.5CH_4$<br>*Toluene oxidation / methanogenesis* | -34.08 | -142.6 | 0.78:1 [b] |

# TABLE 4.3 (continued)

## COUPLED OXIDATION REACTIONS FOR BTEX COMPOUNDS
## UST SITES 10-494, 10-495, AND 10-496
## INTRINSIC REMEDIATION TS
## BEALE AIR FORCE BASE, CALIFORNIA

| Coupled Ethylbenzene Oxidation reactions | $\Delta G°_r$ (kcal/mole Ethyl-benzene) | $\Delta G°_r$ (kJ/mole Ethyl-benzene) | Stoichiometric Mass Ratio of Electron Acceptor to Compound |
|---|---|---|---|
| $10.5O_2 + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5H_2O$ <br> *Ethylbenzene oxidation /aerobic respiration* | -1066.13 | -4461 | 3.17:1 |
| $8.4NO_3^- + 8.4H^+ + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 9.2H_2O + 4.2N_{2,g}$ <br> *Ethylbenzene oxidation / denitrification* | -1080.76 | -4522 | 4.92:1 |
| $84H^+ + \underline{42Fe(OH)_{3,a}} + C_6H_5C_2H_5 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ <br> *Ethylbenzene oxidation / iron reduction* | -778.48 | -3257 | 22:1[a] |
| $10.5H^+ + 5.25SO_4^{2-} + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5.25H_2S^o + 5H_2O$ <br> *Ethylbenzene oxidation / sulfate reduction* | -166.75 | -697.7 | 4.75:1 |
| $5.5H_2O + C_6H_5C_2H_5 \Rightarrow 2.75CO_{2,g} + 5.25CH_4$ <br> *Ethylbenzene oxidation / methanogenesis* | -39.83 | -166.7 | 0.79:1 [b] |

| Coupled m-Xylene Oxidation Reactions | $\Delta G°_r$ (kcal/mole *m*-xylene) | $\Delta G°_r$ (kJ/mole *m*-xylene) | Stoichiometric Mass Ratio of Electron Acceptor to Compound |
|---|---|---|---|
| $10.5O_2 + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5H_2O$ <br> *m-Xylene oxidation /aerobic respiration* | -1063.25 | -4448 | 3.17:1 |
| $8.4NO_3^- + 8.4H^+ + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 9.2H_2O + 4.2N_{2,g}$ <br> *m-Xylene oxidation / denitrification* | -1077.81 | -4509 | 4.92:1 |
| $84H^+ + \underline{42Fe(OH)_{3,a}} + C_6H_4(CH_3)_2 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ <br> *m-Xylene oxidation / iron reduction* | -775.61 | -3245 | 22:1[a] |
| $10.5H^+ + 5.25SO_4^{2-} + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5.25H_2S^o + 5H_2O$ <br> *m-Xylene oxidation / sulfate reduction* | -163.87 | -685.6 | 4.75:1 |
| $5.5H_2O + C_6H_4(CH_3)_2 \Rightarrow 2.75CO_{2,g} + 5.25CH_4$ <br> *m-Xylene oxidation / methanogenesis* | -36.95 | -154.6 | 0.79:1 [b] |

a/ Mass of ferrous iron produced during microbial respiration.

b/ Mass of methane produced during microbial respiration.

# TABLE 4.4
# GROUNDWATER AND SURFACE WATER GEOCHEMICAL FIELD DATA
# MARCH 1996

**UST Sites 10-494, 10-495, and 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

| Location | Dissolved Oxygen (mg/L) | $E_h$ (redox) (mV) | Total Iron (mg/L) | Ferrous ($Fe^{+2}$) Iron (mg/L) | Mn (mg/L) | Carbon Dioxide (mg/L) | Temp.[1] (° C) | pH (units) | EC (µmhos/cm) |
|---|---|---|---|---|---|---|---|---|---|
| MP-03 | 3.40 | 394 | 0.06 | ND | ND | 58 | 15.0 | 6.40 | 235 |
| MP-09 (dup) | 0.45 | 379 | 0.25 (0.35) | 0.09 (ND) | 15.6 (20) | 535 (585) | 18.0 | 6.65 | 4,150 |
| MP-10 | 0.35 | 56 | 15.54 | 5.10 | 13.8 | 290 | 18.0 | 6.63 | 1,650 |
| MP-11 (dup) | 0.20 | 245.7 | 0.09 (0.14) | 0.07 (0.06) | 2.9 (3.4) | 42 (50) | 15.0 | 6.76 | 200 |
| MP-12 | 4.80 | 279.0 | 0.12 | 0.07 | 0.1 | 45 | 17.0 | 7.05 | 650 |
| MP-13 | 0.40 | 128 | 7.86 | 6.84 | 26.4 | 210 | 16.0 | 6.98 | 1,100 |
| MP-14 | 0.15 | 152.2 | 3.92 | 3.70 | 9.8 | 105 | 16.0 | 6.67 | 750 |
| MP-15 | 2.60 | 302.3 | 0.25 | 0.16 | 1.8 | 46 | n.a. | n.a. | n.a. |
| MP-17 | 8.00 | 426.5 | 0.06 | ND | ND | 30 | 16.0 | 6.85 | 180 |
| MP-18 | 5.60 | 370.0 | 0.06 | ND | ND | 34 | 17.3 | 7.90 | 170 |
| MP-19 | n.a. | n.a. | 0.12 | ND | ND | 20 | n.a. | n.a. | n.a. |
| MP-20 | 4.20 | 422 | 0.12 | 0.07 | 0.2 | 60 | 16.5 | 6.42 | 235 |
| MP-21 | 3.90 | 398.5 | 0.14 | 0.06 | ND | 50 | 19.0 | 7.51 | 215 |
| MP-22 (dup) | 0.80 | 83.5 | 0.51 (0.46) | 0.45 (0.34) | 6.6 (8.7) | 60 (55) | 15.5 | 6.99 | 460 |
| MP-24 | 8.40 | 392 | 0.13 | ND | ND | 28 | 16.0 | 6.34 | 145 |
| MP-25 | 5.80 | 402.6 | 0.07 | 0.02 | ND | 34 | 16.5 | 6.65 | 145 |
| MP-26 | 6.50 | 362 | 0.20 | 0.03 | ND | 36 | 15.5 | 6.85 | 118 |
| MP-27 | 6.10 | 372 | 0.10 | ND | ND | 33 | 15.2 | 6.59 | 137 |
| MW-01 | 0.30 | 371 | 0.01 | 0.03 | 2.1 | 84 | 19.0 | 6.66 | 600 |
| MW-02 | 1.80 | 383 | 0.03 | 0.04 | ND | 26 | 19.9 | 8.32 | 220 |
| SW-01 | 10.50 | 360 | n.a. | n.a. | n.a. | n.a. | 20.6 | 8.80 | 85 |
| SW-02 | 11.50 | 354 | n.a. | n.a. | n.a. | n.a. | 24.2 | 8.18 | 280 |
| SW-03 | 10.30 | 373 | n.a. | n.a. | n.a. | n.a. | 22.1 | 8.70 | 85 |

**Notes:**

ND : Not Detected.
n.a. : Not analyzed.
MP-11 (dup) : Primary sample analysis results followed by duplicate analysis results in parentheses.

[1] Measured with dissolved oxygen meter.

$E_h$: Oxidation - Reduction Potential relative to hydrogen.

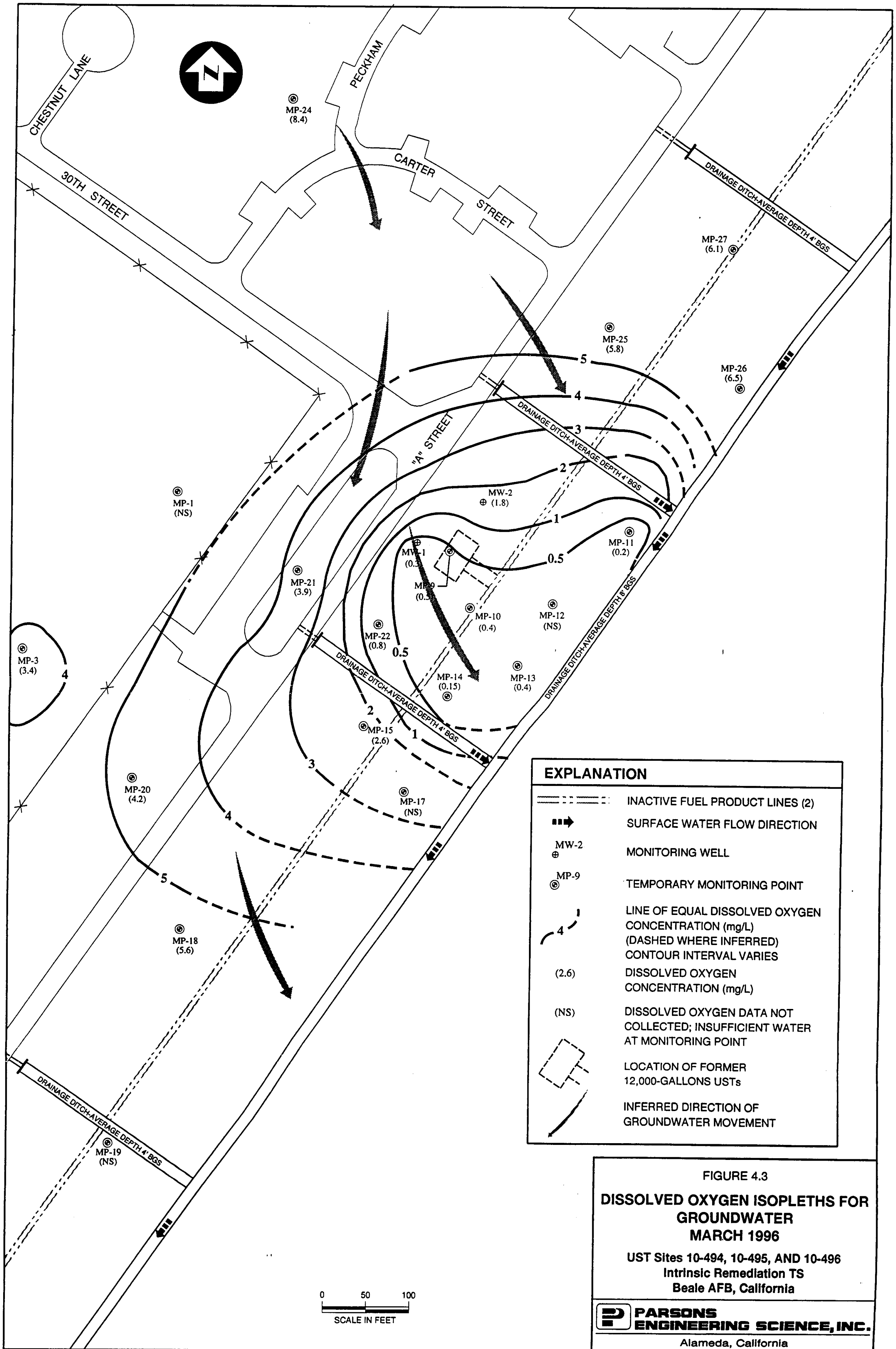


FIGURE 4.3

**DISSOLVED OXYGEN ISOPLETHS FOR GROUNDWATER MARCH 1996**

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

the site in the past because the compost pile may have reduced available upgradient DO through elevated biological oxygen demand (BOD). However the removal of the compost pile in November 1995 and the average background DO concentration of 6.7 mg/L upgradient from the site (Figure 4.3) means that DO will be an important electron acceptor in the future.

MP-12 was not used in developing the DO isopleths. During purging, groundwater flow could not be sustained for a sufficient length of time to allow for DO to stabilize. A review of the boring log for MP-12 shows that the aquifer is very thin in this area of the site and is composed of silty, very fine to fine sand.

The stoichiometry of BTEX mineralization to carbon dioxide and water caused by aerobic microbial biodegradation is presented in Table 4.3. The average mass ratio of oxygen to total BTEX is approximately 3.14 to 1. This translates to the mineralization of approximately 0.32 mg of BTEX for every 1.0 mg of DO consumed. With a maximum observed background DO concentration of 6.7 mg/L, the shallow groundwater at this site has the capacity to assimilate 2.1 mg/L (2,100 µg/L) of total BTEX through aerobic biodegradation. This may be a conservative estimate of the assimilative capacity of DO because microbial cell mass production was not taken into account by the stoichiometry presented in Table 4.3.

As a microbial population in the groundwater grows in response to the introduction of fuel hydrocarbons into the groundwater, some of the fuel is used not only to generate energy, but also to generate cell mass. When cell biomass production is accounted for, the mineralization of benzene to carbon dioxide and water is given by:

$$C_6H_6 + 2.5O_2 + HCO_3 + NH_4 \rightarrow C_5H_7O_2N + 2CO_2 + 2H_2O$$

This equation indicates that 5.0 fewer moles of DO are required to mineralize 1 mole of benzene when cell mass production is taken into account. On a mass basis, the ratio of DO to benzene is given by:

Benzene $6(12) + 6(1) = 78$ gm

Oxygen $2.5(32) = 80$ gm

Mass Ratio of Oxygen to Benzene = $80/78 = 1.03:1$

On the basis of these stoichiometric relationships, 1.03 mg of oxygen are required to mineralize 1 mg of benzene, if cell mass production is taken into account. Similar calculations can be made for toluene, ethylbenzene, and the xylenes. On the basis of these calculations, approximately 0.97 mg of BTEX is mineralized to carbon dioxide and water for every 1.0 mg of DO consumed.

Although this process results in more efficient utilization of electron receptors, it is only applicable as the net cell mass of the microbial population continues to grow. Because groundwater contamination has been present at the UST Site for a number of years, biomass production within the center of the plume may have reached steady state. In such a case, the cell mass reaction equations would no longer apply. However, if the removal of the compost

pile (and its high BOD rates) results in a fresh influx of higher concentrations of DO into the area of the plume previously dominated by anaerobic processes. the higher rates of BTEX degradation could apply.

#### 4.3.2.2 Nitrate/Nitrite

Concentrations of nitrate/nitrite [as nitrogen (N)] were measured in groundwater samples collected in March 1996. Table 4.5 summarizes measured nitrate and nitrite (as N) concentrations. Nitrate concentrations at the site ranged from 0.083 mg/L to 148 mg/L (as N). Nitrite was not detected in any sample. Figure 4.4 is an isopleth map showing the distribution of nitrate (as N) in groundwater. The maximum concentration of nitrate was detected at MP-9 (148 mg/L), which is located within the former excavation pit and compost pile. indicating that the compost pile was probably a significant source of nitrate in the groundwater. The nitrate concentration at MP-9 was two orders of magnitude higher than the average background concentration of 2.0 mg/L.

Comparison of Figure 4.4 with the BTEX plume on Figure 4.1 shows graphically that areas with elevated total BTEX concentrations have depleted nitrate concentrations. Although the former compost pile likely has been supplying nitrate to downgradient MPs. Figure 4.4 shows nitrate depletion in the BTEX plume to concentrations as low as 0.07 mg/L at MP-13. in the center of the BTEX plume. Concentrations of nitrate within the BTEX plume are below average background concentrations of approximately 2.0 mg/L, despite the nitrate source at the compost pile. These relationships provide strong evidence that anaerobic biodegradation of the BTEX compounds is occurring at the site through the microbially mediated process of denitrification.

In the absence of microbial cell production, the stoichiometry of BTEX mineralization to carbon dioxide. water. and nitrogen caused by denitrification is presented in Table 4.3. The average mass ratio of nitrate to total BTEX is approximately 4.9 to 1. or, when the nitrate is measured as N. the mass ratio of nitrate (as N) to total BTEX is 1.1 to 1. This translates to the mineralization of approximately 0.90 mg of BTEX for every 1.0 mg of nitrate (as N) consumed. With an observed average background nitrate concentration (excluding the concentration at MP-9) of 2.0 mg/L (as N), the shallow groundwater at this site has the capacity to assimilate 1.8 mg/L (1,800 μg/L) of total BTEX during denitrification. This may be a conservative estimate of assimilative capacity for nitrate because microbial cell mass production has not been taken into account by the stoichiometry shown above (see Section 4.3.2.1) and because the former compost pile has not been incorporated into the calculation as a source of nitrate.

#### 4.3.2.3 Ferrous Iron

Ferrous iron ($Fe^{2+}$) concentrations were measured in groundwater samples collected in March 1996. Table 4.4 summarizes ferrous iron concentrations. Detected ferrous iron concentrations ranged from 0.02 mg/L to 6.84 mg/L. Figure 4.5 is an isopleth map showing the areal extent of ferrous iron in groundwater. Comparison of Figures 4.1 and 4.5 shows graphically that the area with elevated total BTEX concentrations also has elevated ferrous iron concentrations. Background concentrations of ferrous iron were generally below the

# TABLE 4.5
# GROUNDWATER AND SURFACE WATER GEOCHEMICAL ANALYTICAL DATA
# MARCH 1996
### UST Sites 10-494, 10-495, and 10-496
### Intrinsic Remediation TS
### Beale AFB, California

| Analyte: | Nitrate-Nitrogen | Nitrite-Nitrogen | Sulfate | Methane | Total Alkalinity | Dissolved Ammonia-Nitrogen | Chloride | TOC |
|---|---|---|---|---|---|---|---|---|
| Method: | E300.0 | E300.0 | E300.0 | RSKSOP-175 | E310.1 | E350.3 | E300.0 | E415.1 |
| Location | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) |
| MP-03 | 2.6 | <0.076 | 17.1 | <0.002 | 84.4 | <0.8 | 25.7 | 1.4 |
| MP-09<br>(dup) | 148<br>(141) | <0.76<br>(<0.76) | 467<br>(458) | 3.5<br>(3.9) | 1,220<br>(1,250) | 3.3<br>(1.9) | 925<br>(885) | 102<br>(103) |
| MP-10 | 0.083 | <7.6 | 12.2 | 0.85 | 690 | 1.8 | 348 | 65.7 |
| MP-11<br>(dup) | 0.81<br>(0.80) | <0.076<br>(<0.076) | 7.0<br>(7.0) | 0.176<br>(0.167) | 104<br>(103) | <0.8<br>(<0.8) | 18<br>(16.8) | 2.1<br>(2.2) |
| MP-12 | 0.46 | <0.076 | 21.1 | <0.002 | 213 | <0.8 | 136 | 5.2 |
| MP-13 | 0.067 | <0.76 | 1.1 | 1.6 | 575 | <0.8 | 195 | 36.8 |
| MP-14 | 4.3 | <0.076 | 25.2 | 3.2 | 287 | <0.8 | 142 | 17.6 |
| MP-15 | 0.18 | <0.076 | 11.4 | 0.023 | n.a. | <0.8 | 84.4 | 6.6 |
| MP-17 | 2.5 | <0.076 | 3.4 | <0.002 | 68.7 | <0.8 | 20.3 | 1.5 |
| MP-18 | 2.3 | <0.076 | 7 | <0.002 | 67.6 | <0.8 | 10.9 | 2.2 |
| MP-19 | 2.6 | <0.076 | 25.9 | <0.002 | 91.9 | <0.8 | 103 | 3.2 |
| MP-20 | 2.6 | <0.076 | 11.6 | <0.002 | 84.6 | <0.8 | 25.1 | 1.2 |
| MP-21 | 1.8 | <0.076 | 9.3 | <0.002 | 76.8 | <0.8 | 23.3 | 1.8 |
| MP-22<br>(dup) | 1.8<br>(1.9) | <0.076<br>(<0.076) | 23.5<br>(23.5) | 0.20<br>(0.22) | 181<br>(186) | <0.8<br>(<0.8) | 72.2<br>(70.2) | 4.3<br>(4.6) |
| MP-24 | 2.6 | <0.076 | 9.1 | <0.002 | 52.8 | <0.8 | 11.2 | <1 |
| MP-25 | 1.8 | <0.076 | 5.8 | <0.002 | 60.4 | <0.8 | 10.7 | <1 |
| MP-26 | 1.6 | <0.076 | 4.5 | <0.002 | 52.6 | <0.8 | 8.1 | <1 |
| MP-27 | 1.8 | <0.076 | 5.2 | <0.002 | 59.4 | <0.8 | 10.2 | <1 |
| MW-01 | 3.6 | <0.076 | 26.8 | <0.002 | 177 | <0.8 | 74.6 | 7.3 |
| MW-02 | 2.2 | <0.076 | 8.4 | <0.002 | 86.4 | <0.8 | 13.5 | 1.6 |
| SW-01 | 0.15 | <0.076 | 1.6 | n.a. | 42.2 | n.a. | 2.3 | n.a. |
| SW-02<br>(dup) | 0.12 | <0.076 | 9.9 | n.a. | 92.2<br>(93.2) | n.a. | 33 | n.a. |
| SW-03 | 0.17 | <0.076 | 2.1 | n.a. | 40.3 | n.a. | 5.1 | n.a. |

**Notes:**

| | |
|---|---|
| <0.0002 | : Not detected above given detection limit. |
| n.a. | : Not analyzed. |
| MP-11 (dup) | : Primary sample analysis results followed by duplicate analysis results in parentheses. |

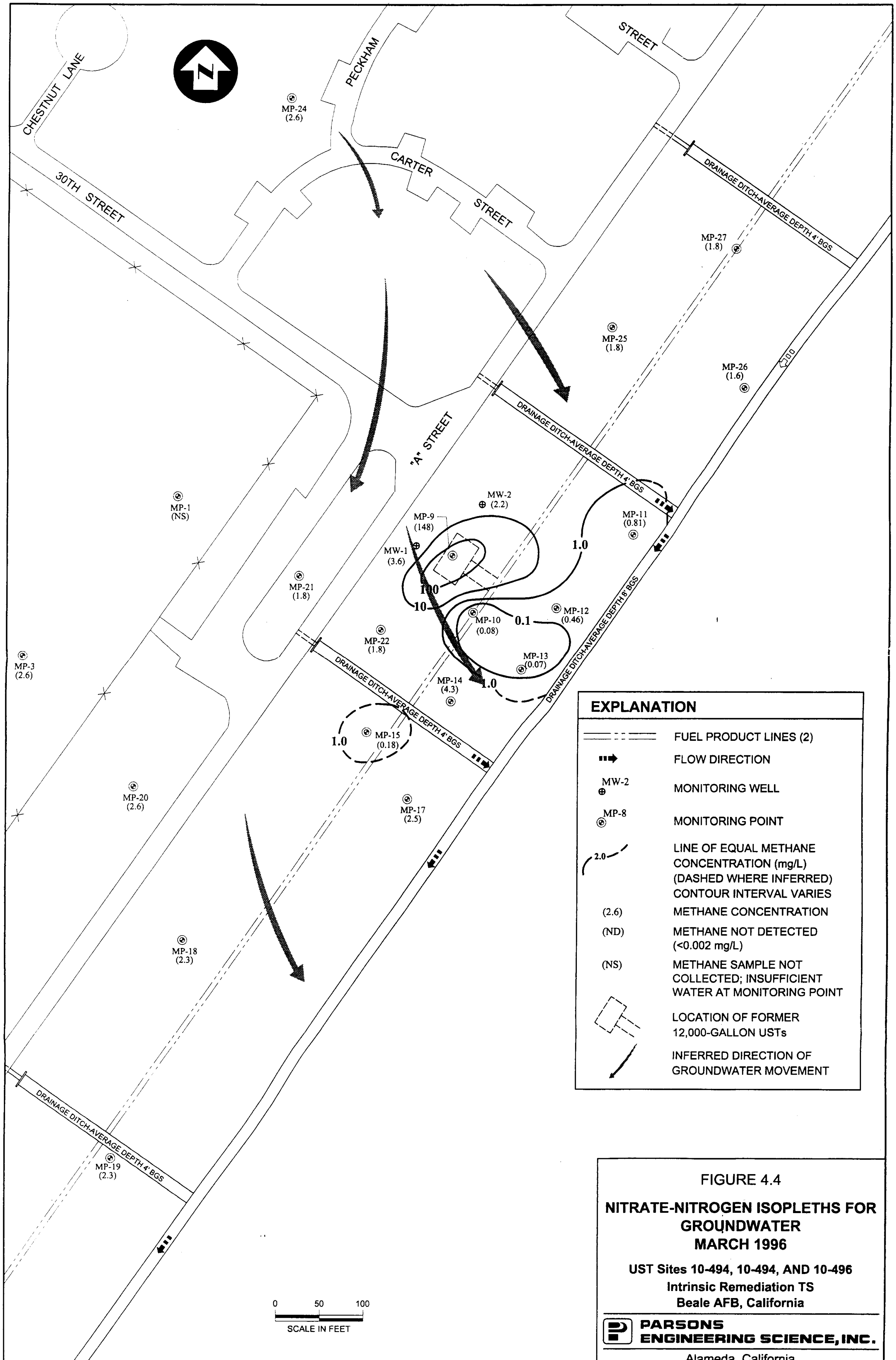


FIGURE 4.4

**NITRATE-NITROGEN ISOPLETHS FOR GROUNDWATER MARCH 1996**

**UST Sites 10-494, 10-494, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

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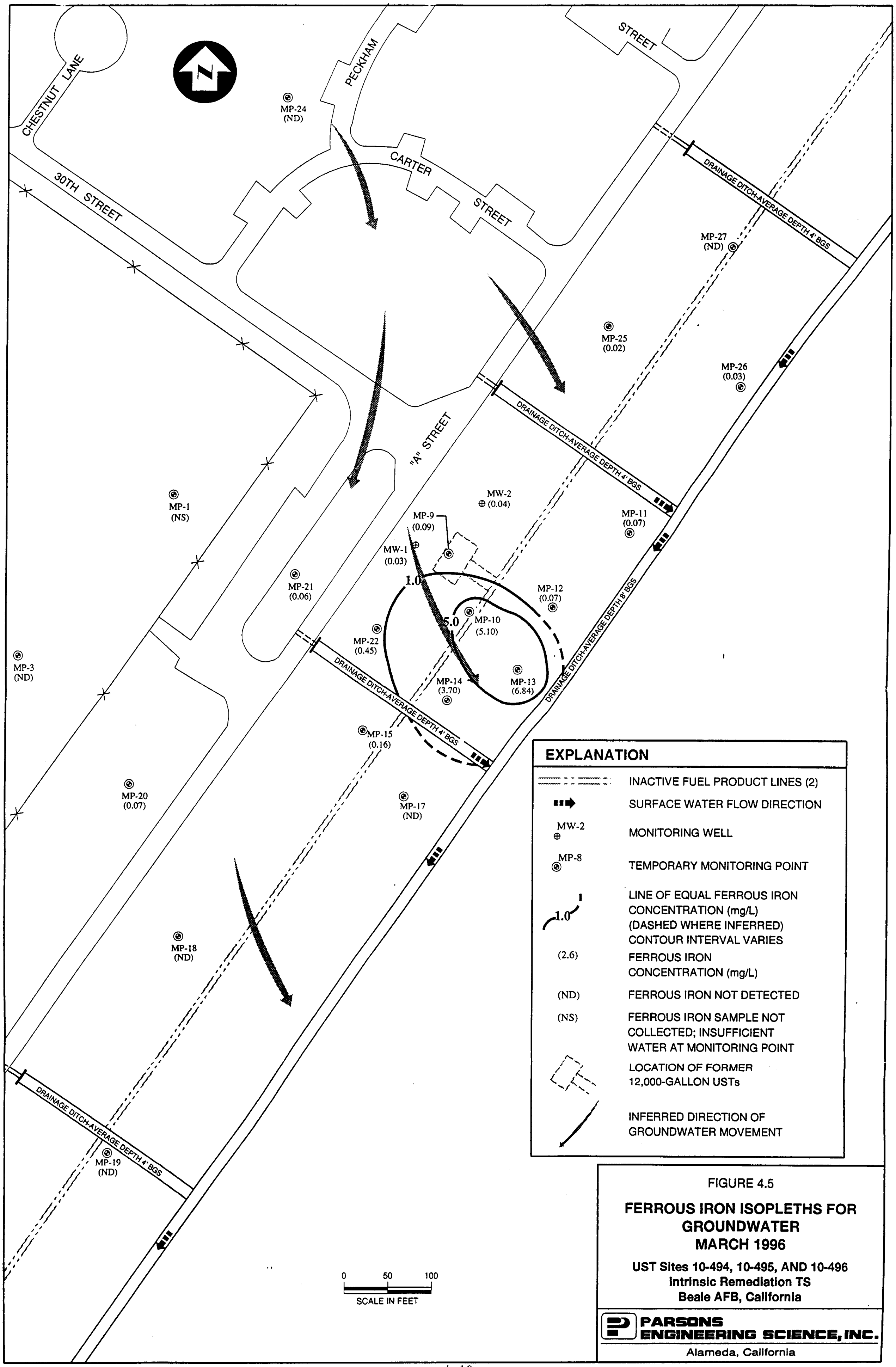


**EXPLANATION**

| | |
|---|---|
| | INACTIVE FUEL PRODUCT LINES (2) |
| | SURFACE WATER FLOW DIRECTION |
| MW-2 | MONITORING WELL |
| MP-8 | TEMPORARY MONITORING POINT |
| 1.0 | LINE OF EQUAL FERROUS IRON CONCENTRATION (mg/L) (DASHED WHERE INFERRED) CONTOUR INTERVAL VARIES |
| (2.6) | FERROUS IRON CONCENTRATION (mg/L) |
| (ND) | FERROUS IRON NOT DETECTED |
| (NS) | FERROUS IRON SAMPLE NOT COLLECTED; INSUFFICIENT WATER AT MONITORING POINT |
| | LOCATION OF FORMER 12,000-GALLON USTs |
| | INFERRED DIRECTION OF GROUNDWATER MOVEMENT |

FIGURE 4.5

**FERROUS IRON ISOPLETHS FOR GROUNDWATER MARCH 1996**

**UST Sites 10-494, 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

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detection limit or at concentrations less than 0.10 mg/L. These relationships provide strong evidence that ferric iron hydroxide is being reduced to ferrous iron through anaerobic biodegradation of the BTEX compounds.

The stoichiometry of BTEX oxidation to carbon dioxide, ferrous iron, and water by iron reduction through anaerobic microbial biodegradation is presented in Table 4.3. On average, 37.5 moles of ferric iron hydroxide are required to metabolize one mole of total BTEX. Conversely, an average of 37.5 moles of ferrous iron are produced for each mole of total BTEX consumed. On a mass basis, this translates to approximately 21.8 mg ferrous iron produced for each 1 mg of total BTEX metabolized. Assuming a background ferrous iron concentration of zero and a maximum detected ferrous iron concentration of 6.84 mg/L at MP-13, the groundwater has the capacity to assimilate approximately 0.31 mg/L (310 µg/L) of total BTEX through iron reduction. This is a conservative estimate of the assimilative capacity of iron because this calculation is based on observed ferrous iron concentrations, and not on the amount of ferric hydroxide available in the aquifer and solid soil matrix. Therefore, iron assimilative capacity could be higher.

Recent evidence suggests that the reduction of ferric iron to ferrous iron cannot proceed at all without microbial mediation (Lovley and Phillips, 1988; Lovley *et al.*, 1991; Chapelle, 1993). None of the common organic compounds found in low-temperature, neutral, reducing groundwater could reduce ferric oxyhydroxides to ferrous iron under sterile laboratory conditions (Lovley *et al.*, 1991). This means that the reduction of ferric iron requires microbial mediation by microorganisms with the appropriate enzymatic capabilities. Because the reduction of ferric iron cannot proceed without microbial intervention, the elevated concentrations of ferrous iron that were measured in the contaminated groundwater at the site are very strong indicators of microbial activity.

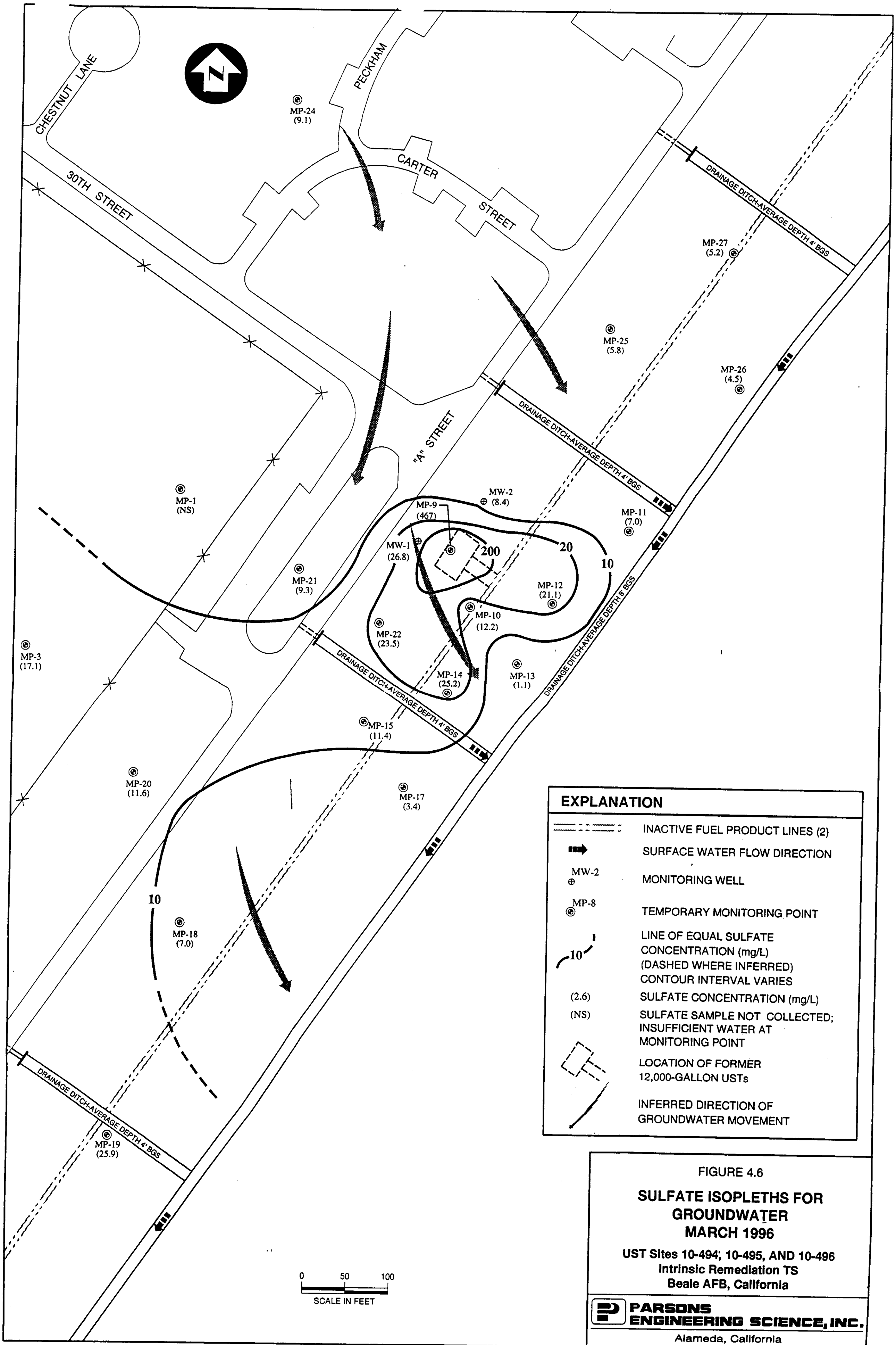
#### 4.3.2.4 Sulfate

Sulfate concentrations in groundwater were measured at the site in March 1996. Table 4.5 summarizes sulfate concentrations. Sulfate concentrations ranged from 1.1 mg/L at MP-13 to 467 mg/L at MP-9. Figure 4.6 is an isopleth map showing the areal extent of sulfate in the groundwater.

The former compost pile appears to be a significant source of sulfate, similar to the results obtained for nitrate and discussed in Section 4.3.2.2. However, a comparison of sulfate concentrations relative to the BTEX plume does not show a definite pattern of sulfate depleted below background concentrations within the plume. Therefore, sulfate reduction is not considered an important process contributing to the natural attenuation of petroleum hydrocarbons at this site.

#### 4.3.2.5 Methane

Methane concentrations were measured in groundwater samples collected in March 1996. Table 4.5 summarizes methane concentrations, which range from less than 0.002 to 3.5 mg/L. Figure 4.7 is an isopleth map showing the distribution of methane in groundwater. As




**EXPLANATION**

| | |
|---|---|
| | INACTIVE FUEL PRODUCT LINES (2) |
| | SURFACE WATER FLOW DIRECTION |
| MW-2 | MONITORING WELL |
| MP-8 | TEMPORARY MONITORING POINT |
| 10 | LINE OF EQUAL SULFATE CONCENTRATION (mg/L) (DASHED WHERE INFERRED) CONTOUR INTERVAL VARIES |
| (2.6) | SULFATE CONCENTRATION (mg/L) |
| (NS) | SULFATE SAMPLE NOT COLLECTED; INSUFFICIENT WATER AT MONITORING POINT |
| | LOCATION OF FORMER 12,000-GALLON USTs |
| | INFERRED DIRECTION OF GROUNDWATER MOVEMENT |

FIGURE 4.6

**SULFATE ISOPLETHS FOR GROUNDWATER MARCH 1996**

**UST Sites 10-494; 10-495, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

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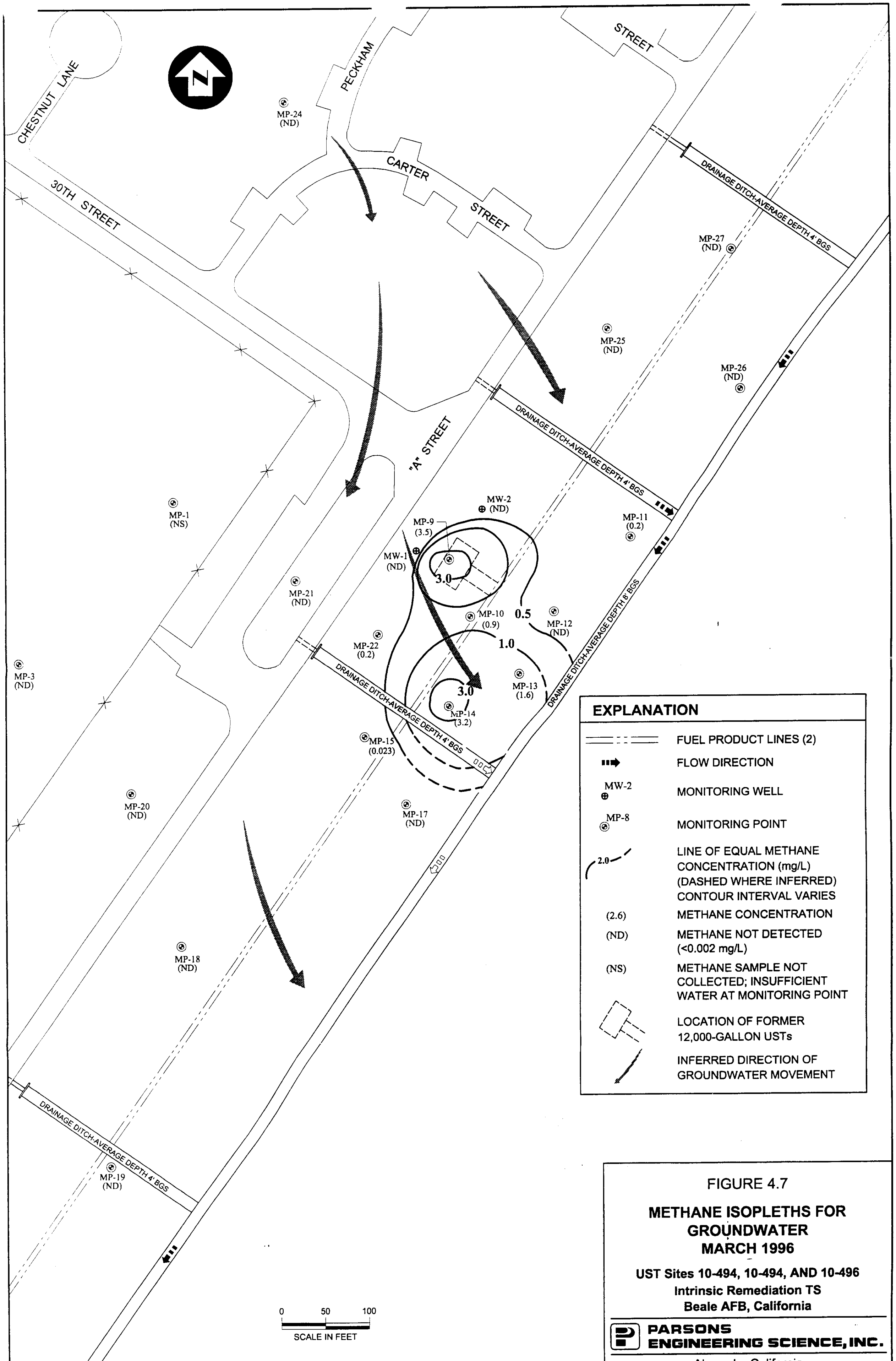



FIGURE 4.7

**METHANE ISOPLETHS FOR GROUNDWATER MARCH 1996**

**UST Sites 10-494, 10-494, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

REV. 4 BE907-02a.DWG

with nitrate and sulfate, the compost pile appears to be a significant source of methane to the groundwater.

However, elevated concentrations of methane also were detected at MP-14, where the highest concentration of BTEX was detected, and the methane concentration was depleted at MP-10. located along the groundwater flow path between the compost pile and MP-14. These results suggest that methanogenesis may be occurring at the site; however, the evidence is not conclusive because of the source of methane at the former compost pile. To be conservative. methanogenesis is not considered an important process contributing to the natural attenuation of petroleum hydrocarbons at this site.

#### 4.3.2.6 Reduction/Oxidation Potential

Redox potentials were measured in groundwater samples collected in March 1996. Redox potential is a measure of the relative tendency of a solution to accept or transfer electrons. The redox potential of a groundwater system depends on which electron acceptors are being reduced by microbes during BTEX oxidation. The redox potential at the site ranges from 56 millivolts (mV) to 426 mV, as measured relative to hydrogen. Table 4.4 summarizes available redox potential data. The areal extent of redox potentials is illustrated graphically on Figure 4.8. As expected, areas at the site with low redox potentials coincide with areas of high BTEX contamination, low DO and nitrate concentrations, and elevated ferrous iron concentrations.

The redox potentials measured at the site are higher than the theoretical optimum redox potentials for various electron acceptor reactions (Norris *et al.*, 1994). This discrepancy is a common problem associated with measuring oxidizing potential using field instruments. Platinum electrode probes used in field instruments are not sensitive to the some of the redox couples (e.g., sulfate/sulfide). Many authors have noted that field measured redox data alone cannot be used to reliably predict the electron acceptors that may be operating at a site (Stumm and Morgan. 1981; Godsey, 1994; Lovley *et al.*, 1994). Integrating redox measurements with analytical data on reduced and oxidized chemical species allows a more thorough and reasonable interpretation of which electron acceptors are being used to biodegrade site contaminants.

#### 4.3.2.7 Alkalinity and Carbon Dioxide Evolution

Carbon dioxide is produced during the bioremediation of petroleum hydrocarbons. In aquifers that have carbonate materials as part of the matrix, carbon dioxide forms carbonic acid. which dissolves these minerals, increasing the alkalinity of the groundwater. An increase in alkalinity (measured as $CaCO_3$) above background conditions in an area with elevated BTEX concentrations can be used to infer the amount of petroleum hydrocarbon destroyed through aerobic respiration, denitrification, manganese reduction, ferric iron reduction, and sulfate reduction. In addition, carbon dioxide produced in these aerobic and anaerobic reactions can be cycled in the methanogenic reactions to continue BTEX biodegradation through methanogenesis.

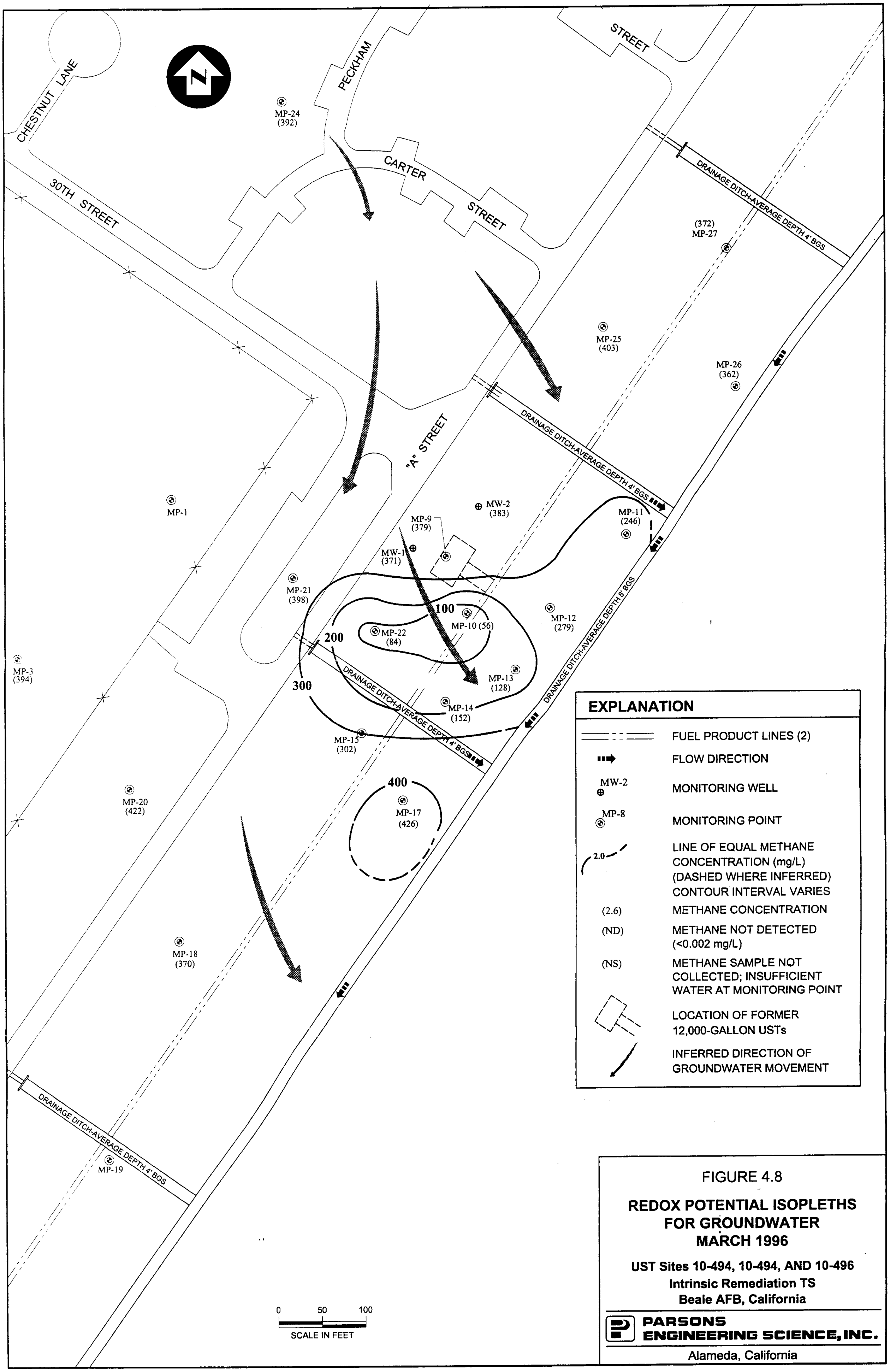



FIGURE 4.8

**REDOX POTENTIAL ISOPLETHS FOR GROUNDWATER MARCH 1996**

**UST Sites 10-494, 10-494, AND 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

**PARSONS ENGINEERING SCIENCE, INC.**
Alameda, California

REV. 3 BE907-09a.DWG

Free carbon dioxide was measured in groundwater samples collected in March 1996 (Table 4.4). Carbon dioxide evolution above background concentrations is occurring as a result of biodegradation processes related either to the compost pile or BTEX; however, it is not possible to distinguish the two processes from each other. A direct estimate of the aquifer assimilative capacity based on carbon dioxide evolution is not possible because of the complex carbonate/bicarbonate balance.

Total alkalinity (as $CaCO_3$) was also measured in groundwater samples collected in March 1996 (Table 4.5). Alkalinity is a measure of the ability of groundwater to buffer changes in pH caused by the addition of biologically generated acids. Alkalinity also can be used in certain situations to estimate the assimilative capacity of groundwater (Wiedemeier *et al.*, 1995). Total alkalinity measured at the site was relatively high and varied from 52.8 mg/L to 1,220 mg/L. Increases in alkalinity above background concentrations coincided with elevated carbon dioxide concentrations. Unfortunately, the production of carbon dioxide through elevated BOD from the compost pile prevented an estimate of the assimilative capacity of groundwater to degrade BTEX using alkalinity. However, the alkalinity concentrations and increases in carbon dioxide concentrations above background are supportive of an amenable environment for intrinsic biodegradation, and the alkalinity of site groundwater should be sufficient to buffer potential changes in pH caused by biologically mediated BTEX oxidation reactions.

#### 4.3.2.8 pH

The pH was measured for groundwater samples collected in March 1996 (Table 4.4). The pH of a solution is the negative logarithm of the hydrogen ion concentration $[H^+]$. The optimal range of pH for BTEX-degrading microbes is between 6 and 8 standard units (Wiedemeier *et al.*, 1995). Only one groundwater sample, from MW-2, was slightly outside this range, at a pH of 8.32.

#### 4.3.2.9 Temperature

The temperature of groundwater measured at the site in March 1996 is shown in Table 4.4. Temperature affects the type and growth rates of bacteria that can be supported in the groundwater environment. Temperatures in the shallow saturated zone varied from 15.0°C to 19.9°C. These are moderately warm temperatures for shallow groundwater, suggesting that bacterial growth rates should be stimulated.

### 4.3.3 Discussion

Three lines of evidence can be used to document the occurrence of natural attenuation: 1) geochemical evidence; 2) documented loss of contaminant mass at the field scale; and 3) laboratory microcosm studies. The first two lines of evidence (geochemical evidence and documented loss of contaminants) are used herein to support the occurrence of natural attenuation at the UST Site, as described in the previous sections. Because these two lines of evidence strongly suggest that natural attenuation is occurring at this site, laboratory microcosm studies were not deemed necessary.

Numerous laboratory and field studies have shown that hydrocarbon-degrading bacteria can participate in the degradation of many of the chemical components of jet fuel and gasoline, including the BTEX compounds (e.g., Jamison *et al.*, 1975; Atlas, 1981, 1984, 1988; Gibson and Subramanian, 1984; Reinhard *et al.*, 1984; Young, 1984; Bartha, 1986; Wilson *et al.*, 1986, 1987, and 1990; Barker *et al.*, 1987; Baedecker *et al.*, 1988; Lee, 1988; Chiang *et al.*, 1989; Grbic-Galic, 1989 and 1990; Cozzarelli *et al.*, 1990; Leahy and Colewell, 1990; Altenschmidt and Fuchs, 1991; Alvarez and Vogel, 1991; Baedecker and Cozzarelli, 1991; Ball *et al.*, 1991; Bauman, 1991; Borden, 1991; Brown *et al.*, 1991; Edwards *et al.*, 1991 and 1992; Evans *et al.*, 1991a and 1991b; Haag *et al.*, 1991; Hutchins and Wilson, 1991; Hutchins *et al.*, 1991a and 1991b; Beller *et al.*, 1992; Bouwer, 1992; Edwards and Grbic-Galic, 1992; Thierrin *et al.*, 1992; Malone *et al.*, 1993; Davis *et al.*, 1994). Biodegradation of fuel hydrocarbons can occur when an indigenous population of hydrocarbon-degrading microorganisms is present in the aquifer and sufficient concentrations of electron acceptors and nutrients, including fuel hydrocarbons, are available to these organisms.

Comparison of BTEX, electron acceptor, and biodegradation byproduct isopleth maps (Figures 4.1 and 4.3 through 4.7) for the UST Site provides strong qualitative evidence of biodegradation of BTEX compounds. Isopleth maps suggest that the following electron acceptors are active in the biodegradation of BTEX compounds at the UST Site: DO, nitrate, and ferric iron (indicated by the presence of ferrous iron). Typically, zones of depleted oxygen, depleted nitrate, and elevated ferrous iron concentrations coincide through the core region of the BTEX plume because of the preferred order of electron receptor utilization as redox potential declines. At the UST Site, the sequence of electron acceptor use can be interpreted from the isopleths presented on Figures 4.3, 4.4, and 4.5 where the extent of the elevated or depleted concentrations generally decreases in order of decreasing energy yield.

#### <u>4.3.4 Expressed Assimilative Capacity</u>

The data presented in the preceding sections strongly suggest that mineralization of BTEX compounds is occurring through the microbially mediated processes of aerobic respiration, denitrification, and iron reduction. On the basis of the stoichiometry presented in Table 4.3, the expressed BTEX assimilative capacity of groundwater at the UST Site is approximately 4,200 μg/L (Table 4.6). The primary mechanism is aerobic degradation, which accounts for approximately 2,100 μg/L of expressed BTEX assimilative capacity. However, denitrification is an effective secondary mechanism, accounting for 1,800 μg/L of expressed BTEX assimilative capacity. Sulfate reduction and methanogenesis may further contribute to the system's assimilative capacity; however, their impact is unclear as a result of the former composting operations at the site. Because of the removal of the compost pile, the groundwater geochemistry at the site can be expected to change within the next few years. It is recommended that the assimilative capacity of site groundwater be reevaluated during LTM at this site.

A closed system with 2 liters of water can be used to help visualize the physical meaning of assimilative capacity. Assume that the first liter contains no fuel hydrocarbons, but that it contains fuel degrading microorganisms and has an assimilative capacity of exactly "$x$" μg of fuel hydrocarbons. The second liter has no assimilative capacity; however, it contains fuel

# TABLE 4.6
# ASSIMILATIVE CAPACITY OF SITE GROUNDWATER
### UST Sites 10-494, 10-495, and 10-496
### Intrinsic Remediation TS
### Beale AFB, California

| Electron Acceptor or Process | BTEX Assimilative Capacity (µg/L) |
|---|---|
| Dissolved Oxygen | 2,100 |
| Denitrification | 1,800 |
| Iron Reduction | 310 |
| Expressed Assimilative Capacity | 4,210 |
| Highest Observed Total BTEX Concentration | 71.1 |

hydrocarbons. As long as these 2 liters of water are kept separate, biodegradation of the fuel hydrocarbons will not occur. If these 2 liters are combined in a closed system, biodegradation will commence and continue until the fuel hydrocarbons are depleted, the electron acceptors are depleted, or the environment becomes acutely toxic to the fuel-degrading microorganisms. Assuming a nonlethal environment, if fewer than "*x*" µg of fuel hydrocarbons were in the second liter, all of the fuel hydrocarbons will eventually degrade given a sufficient time; likewise, if greater than "*x*" µg of fuel hydrocarbons were in the second liter of water, only "*x*" µg of fuel hydrocarbons would ultimately degrade.

The groundwater beneath a site is an open system, which continually receives additional electron receptors from through the flow of the aquifer. This means that the assimilative capacity is not fixed as it is in a closed system, and therefore cannot be compared directly to contaminant concentration in the groundwater. Rather, the expressed assimilative capacity of groundwater is intended to serve as a qualitative tool. Although the expressed assimilative capacity at this site is greater than the highest measured total BTEX concentration, the fate of BTEX in groundwater and the potential impact to receptors is dependent on the relationship between the kinetics of biodegradation and the solute transport velocity (Chappelle, 1994). However, this significant expressed assimilative capacity is a strong indicator that an environment conducive to biodegradation of BTEX is present, and that the groundwater appears to have sufficient assimilative capacity to degrade the observed dissolved BTEX and limit plume migration.

# SECTION 5

# GROUNDWATER MODEL

## 5.1 GENERAL OVERVIEW AND MODEL DESCRIPTION

In order to help estimate degradation rates for dissolved BTEX compounds at the UST Site and to help predict the future migration of these compounds, Parsons ES modeled the fate and transport of the dissolved BTEX plume. The modeling effort had three primary objectives: 1) to predict the future extent and concentration of the dissolved contaminant plume by modeling the combined effects of advection, dispersion, sorption, and biodegradation; 2) to assess the potential for possible downgradient receptors to be exposed to contaminant concentrations greater than regulatory levels; and 3) to provide technical support for the evaluation of the RNA option at post-modeling regulatory negotiations. The model was developed using site-specific data and conservative assumptions about governing physical and chemical processes. Due to the conservative nature of the model input, the reduction in contaminant mass resulting from the process of natural attenuation is expected to exceed model predictions. This analysis is not intended to represent a baseline assessment of potential risks posed by site contamination.

The Bioplume II code was used to estimate the potential for dissolved BTEX migration and degradation by naturally occurring mechanisms operating at the UST Site. The Bioplume II model incorporates advection, dispersion, sorption, and biodegradation to simulate contaminant plume migration and degradation. The model is based upon the U.S. Geological Survey (USGS) Method of Characteristics (MOC) two-dimensional (2-D) solute transport model of Konikow and Bredehoeft (1978). The model was modified by researchers at Rice University to include a biodegradation component that is activated by a superimposed DO plume. On the basis of the work of Borden and Bedient (1986), the model assumes a reaction between DO and BTEX that is instantaneous relative to the advective groundwater velocity. Bioplume II solves the USGS 2-D solute transport equation twice, once for hydrocarbon concentrations in the aquifer and once for a DO plume. The two plumes are combined using superposition at every particle move to simulate the instantaneous, biologically mediated reaction between hydrocarbons and oxygen.

In recent years it has become apparent that anaerobic processes such as denitrification, iron reduction, sulfate reduction, and methanogenesis can be important BTEX degradation mechanisms (Grbic′-Galic′, 1990; Beller *et al.*, 1992; Edwards *et al.*, 1992; Edwards and Grbic′-Galic′, 1992; Grbic′-Galic′ and Vogel, 1987; Lovley *et al.*, 1989; Hutchins, 1991). Because geochemical evidence strongly supports the occurrence of anaerobic biodegradation processes at the UST Site (Section 4.3.2), the combined processes of aerobic and anaerobic biodegradation were considered in modeling BTEX fate and transport at the site. The

following subsections discuss in detail the input parameters, the model assumptions, the model calibration, and the simulation results.

## 5.2 CONCEPTUAL MODEL DESIGN AND ASSUMPTIONS

Prior to developing a groundwater model, it is important to determine if sufficient data are available to provide a reasonable estimate of aquifer conditions. In addition, it is important to ensure that any limiting assumptions can be justified. The most important assumption made when using the Bioplume II model is that oxygen-limited biodegradation is occurring at the site. The Bioplume II model assumes that the limiting factors for biodegradation are: 1) the presence of an indigenous hydrocarbon-degrading microbial population, and 2) sufficient background electron acceptor concentrations. Data and information presented in Sections 3 and 4 suggest that oxygen, nitrate, and ferric hydroxide are being used as electron acceptors for aerobic and anaerobic biodegradation.

On the basis of the data presented in Section 3, the aquifer is vertically defined by a layer of silty and/or gravelly fine- to coarse-grained sand. The majority of dissolved BTEX contamination preferentially migrates from the site in this sandy, alluvial layer that is 2 to 7 feet thick across most of the site. An underlying silty clay/clayey silt appears to restrict the vertical movement of groundwater, and the aquifer appears to be confined due to an overlying gravelly and sandy clay. The site is bounded on the east-southeast by a drainage channel that contains water year round and appears to intersect the upper coarse-grained layer. Groundwater enters the site from the northwest and flows across the site toward the drainage channel (Figure 3.10). The drainage channel appears to be a discharge point for the shallow groundwater as discussed in Section 3.3.2.1.

The aquifer was conceptualized and modeled as a shallow, confined aquifer composed of fine- to coarse-grained sand with some silt and clay fractions (Figures 3.8 and 3.9). The average saturated thickness of the aquifer was estimated at 4.5 feet. The model assumes horizontal flow with uniform velocity and direction. The use of a 2-D model is appropriate at the UST Site because the aquifer is relatively homogeneous and is bounded both above and below by clays and/or silts, which should inhibit vertical migration of dissolved BTEX contamination. Since a vertical mixing zone is not used in the model, the concentration front is assumed to be equivalent along the entire aquifer thickness.

BTEX was assumed to emanate from a fringe of soil contamination on the southern and northwestern sides of the former UST excavation based on analytical results from MP-10 (Table 4.1), soil vapor results for SVP-132 and SVP-142 (Appendix B and Figure 2.1), and previous observations of LNAPL during installation of SVP-132, SVP-142, and SB-6 (Appendix B). No additional fuel releases are expected at the site, and only BTEX contamination from the residual LNAPL contamination at the site was considered as a continuing source for the dissolution of BTEX into groundwater over time.

## 5.3 INITIAL MODEL SETUP

The setup for this model was based on available site data. Where site-specific data were not available (e.g., effective porosity), reasonable assumptions were made on the basis of widely accepted literature values for the types of materials comprising the shallow aquifer. The

following sections describe the basic model setup. Those Bioplume II model parameters that were varied during model calibration are discussed in Section 5.4.

### 5.3.1 Grid Design and Boundary Conditions

The maximum grid size for the Bioplume II model is limited to 20 columns by 30 rows. The dimension of each column and row can range from 0.1 to 999.9 feet. A 20- by 30-cell grid was used to model the UST Site. Each grid cell was defined as 20 feet wide by 20 feet long. The grid was oriented with the 30-cell dimension parallel to the large drainage channel in order to maximize the number of cells available for the model domain and minimize uneven boundary effects on cells near the drainage channel. The orientation results in a grid with a slightly offset direction from the dominant groundwater flow direction. However, this orientation is not expected result in a calibrated model with any additional sensitivity or error than that which would be imposed by reducing the number of cells or introducing uneven boundary effects. The grid encompasses the existing BTEX plume and covers an area of approximately 202,000 square feet, or 4.5 acres. The full extent of the model grid is indicated on Figure 5.1.

Model boundaries are mathematical statements that represent hydrogeologic boundaries, such as areas of specified head (i.e., surface water bodies or contour lines of constant hydraulic head) or specified flux. Hydrogeologic boundaries are represented by three mathematical statements that describe the hydraulic head at the model boundaries. These include:

- Specified-head boundaries (Dirichlet condition) for which the head is determined as a function of location and time only. Surface water bodies exhibit constant-head conditions. Specified-head boundaries are expressed mathematically as:

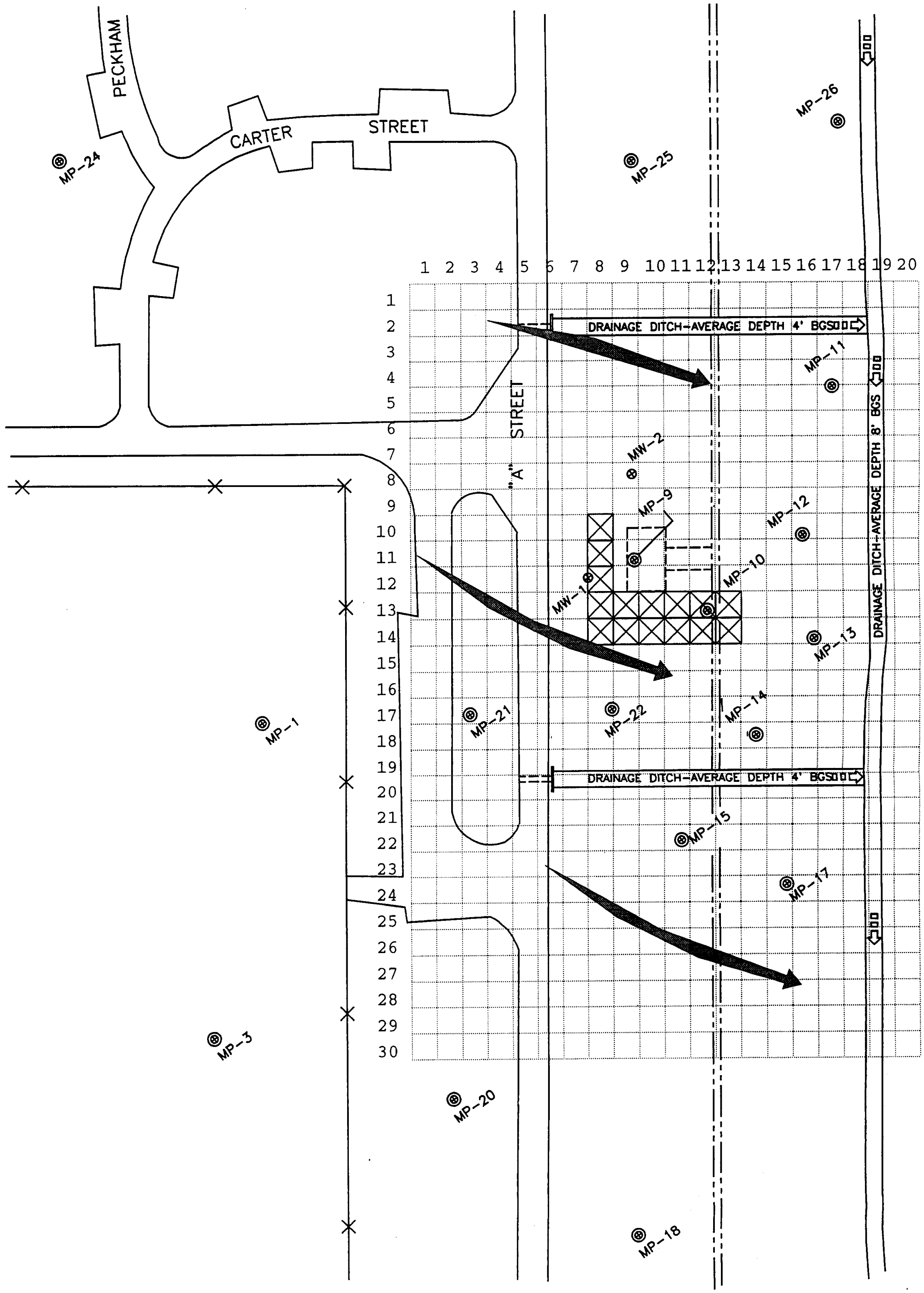
  $$Head = f(x,y,z,t)$$

  where $f$ is the function symbol; $x$, $y$, and $z$ are position coordinates; and $t$ is time.

- Specified-flow boundaries (Neumann conditions) for which the mathematical description of the flux across the boundary is given. The flux is defined as a volumetric flow rate per unit area (i.e., cubic feet per square foot per day [$ft^3/ft^2$/day]). No-flow boundaries are a special type of specified-flow boundary and are set by specifying the flux to be zero. Examples of no-flow boundaries include groundwater divides and impermeable hydrostratigraphic units. Specified-flux boundaries are expressed mathematically as:

  $$Flux = f(x,y,z,t)$$

- Head-dependent flow boundaries (Cauchy or mixed-boundary conditions) where the flux across the boundary is calculated from a given boundary head value. This type of flow boundary is sometimes referred to as a mixed-boundary condition because it is a combination of a specified-head boundary and a specified-flow boundary. Head-dependent flow boundaries are used to model leakage across semipermeable boundaries. Head-dependent flow boundaries are expressed mathematically as (Bear, 1979):




EXPLANATION

CELL WITH SIMULATED INJECTION WELL

INFERRED DIRECTION OF GROUNDWATER MOVEMENT

FIGURE 5.1

**MODEL GRID**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_P11.CDR 10/28/96

$$Flux = \frac{(H_0 - H)K'}{B'}$$

Where: H = Head in the zone being modeled (generally the zone containing the contaminant plume)

$H_0$ = Head in external zone (separated from plume by semipermeable layer)

K' = Hydraulic conductivity of semipermeable layer

B' = Thickness of semipermeable layer

Natural hydraulic boundaries are modeled using a combination of the three types of model boundary conditions listed above. When possible, hydrologic boundaries such as surface water bodies, groundwater divides, contour lines, or hydrologic barriers should coincide with the perimeter of the model. In areas lacking obvious hydrologic boundaries, specified-head or specified-flux boundaries can be specified at the model perimeter if the boundaries are far enough removed from the contaminant plume that transport calculations are not affected. Bioplume II requires the entire model domain to be bounded by zero-flux cells (also known as no-flow cells), with other boundary conditions established within the subdomain specified by the no-flow cells.

Specified-head boundaries for the model were set in the northwestern corner of the model grid, where groundwater enters the site, and along the entire southeastern side of the model grid, coinciding with the surface water in the drainage channel. Typically in 2-D models, two rows of specified-head boundaries (along the top and bottom of the grid) are sufficient to simulate the flow of groundwater for sites that are not hydrogeologically complex or are bounded by adjacent lakes or streams. However, placement of specified-head cells on portions of three sides of the model grid for the UST Site was appropriate and necessary because of the surface water in the drainage channel and in order to correctly simulate the groundwater entering the site from the northwest. Using no flow boundaries for the remaining cells along the north, south, and west boundaries of the grid was appropriate because the potentiometric surface lines are approximately perpendicular to the model grid in these locations or are far enough removed from the area of interest (Figure 3.10).

The constant-head boundaries in the northwestern corner of the grid were chosen where the groundwater potentiometric surface map indicated constant-head contours (Figure 3.8). Constant-head values for the southeastern side of the grid were based on the surveyed surface water elevations (Table 3.2) and estimated upgradient and downgradient surface water levels in the drainage channel. The heads of the northwestern boundary were estimated to be from 129.75 to 129.5 feet above msl and represents the groundwater potentiometric surface in this portion of the site. The heads of the eastern boundary were estimated to vary from 126.09 to 124.5 feet above msl from north to south, respectively.

The base or lower boundary of the model is assumed to be no-flow and is defined by the underlying silt/clay at approximately 10 feet bgs. The upper model boundary is defined by the bottom of the overlying clay/silt aquitard located approximately 5 feet bgs.

### 5.3.2 Groundwater Elevation and Gradient

The March 1996 groundwater potentiometric surface map presented in Figure 3.10 was used to define the heads used as initial input into the Bioplume II model. The gradient range over the modeled area is approximately 0.0062 ft/ft to 0.018 ft/ft. Gradients are lowest upgradient from the contaminated source area and highest downgradient from the source area near MP-14 and the large drainage channel.

As discussed in Section 3.3.2.1, a slightly more southerly groundwater flow direction and lower hydraulic gradients are expected during the drier summer months. The groundwater potentiometric surface is also probably responsive to precipitation recharge, and will likely increase during the principal rainy season from November through April, and experience a subsequent decline during the main dry season from May through October. As described in Section 5.4.1, the model was calibrated to a reasonable match of the observed March 1996 potentiometric surface, which is expected to represent average site conditions.

### 5.3.3 BTEX Concentrations

As noted in Section 5.2, dissolved BTEX is assumed to enter groundwater at the UST Site from migration of recharge (precipitation) through soil containing residual LNAPL above the saturated zone (i.e., through leaching). The suspected areal extent of the residual LNAPL is estimated at approximately 6,000 square feet, surrounding the southern and northwestern portions of the former tank excavation pit (see Section 5.2). This estimate is based on observations of residual LNAPL and soil vapor sampling results from around the former excavation during previous investigations (Appendix B), and on the detection of TPH contamination at a concentration of 780 mg/kg at MP-10 (Table 4.2), located just outside the former excavation area. The area of residual LNAPL was accommodated in the model by 15 simulated injection wells, each within one 20-foot by 20-foot grid cell, to simulate the dissolution of BTEX compounds (Figure 5.1). The injection volume for the injection wells was set at a rate low enough that the hydraulic calibration for the model was not affected.

The total dissolved BTEX concentrations obtained from laboratory analytical results for each well and monitoring point location were used for model development. Table 4.1 presents dissolved BTEX concentration data, and isopleths of dissolved BTEX concentrations are shown on Figure 4.1. Section 5.3.4 describes the methods used to estimate the BTEX leaching rates from residual LNAPL used to calibrate the observed BTEX plume.

### 5.3.4 Source Estimate of Residual LNAPL Contamination

Groundwater can become contaminated when BTEX leaches from residual LNAPL contamination and into groundwater via infiltrating precipitation. As discussed in Section 3.4, recharge likely occurs on a seasonal basis even though the estimated annual ET rate is higher than the annual precipitation rate. An estimated 5 percent of annual rainfall (22.2 inches) is expected to reach the groundwater at the site. The remaining precipitation was assumed to be lost to runoff, evaporation, and ET. Evaporation was considered a large component of precipitation loss because the low-permeability clay/silt layer near the surface of the site (Figures 3.8 and 3.9) contribute to the pooling of water in depressions. The smaller drainage ditches north and south of the site carry some overland runoff into the larger

drainage channel; however, the site is relatively flat, as indicated by the surveyed elevations (Table 3.1). ET occurs across the site in the vegetated site areas, covered by open grassland. For these reasons, the estimated recharge rate of 5 percent per year was considered reasonable given site topography, stratigraphy, and ground cover.

The partitioning of total BTEX from soil into downward percolating precipitation is dominated by three conditions: 1) the concentrations of BTEX in the contaminated soil, 2) the concentrations of BTEX already present in the percolating precipitation, and 3) the contact time between the infiltrating water and the contaminated soil. It was assumed that rainwater percolating into the soil at the site is initially devoid of BTEX contamination. Contact time between infiltrating water and the soil contamination is dependent on the downward percolation rate. This parameter is difficult to estimate due to the influences of season, temperature, soil moisture, porosity, and soil type. To be conservative, it was assumed that all infiltrating water contacting areas of soil contamination were under equilibrium conditions. This means that infiltrating water would be in contact with contaminated soil for a sufficient length of time to allow maximum concentration of each of the BTEX compounds to dissolve and reach underlying groundwater.

On the basis of the work described by Bruce *et al.* (1991), the equilibrium saturation concentration of fuel hydrocarbon compounds in water can be estimated by:

$$C_w = C_f/K_{fw}$$

where:

$C_w$ = Concentration of a compound in aqueous solution
$C_f$ = Concentration of a compound in source soil
$K_{fw}$ = Partitioning coefficient

The fraction of BTEX in weathered residual LNAPL was estimated by computing the ratio of soil BTEX to soil TPH using the assumption that soil TPH concentrations were representative of the total fuel mass sorbed to the soil. This fraction was then compared to the fraction of BTEX in unweathered gasoline to estimate a concentration of BTEX in the weathered residual LNAPL in units of µg/L. The concentration was used to estimate the potential leaching rate of BTEX to groundwater in the areas of residual soil contamination at the site. The BTEX and TPH concentrations used for the leaching rate estimate were taken from sampling location MP-10 because it was adjacent to the former excavation pit and was the location where the maximum concentrations of BTEX and TPH were detected in soil. Therefore, the estimate is considered conservative for any remaining residual LNAPL at the site because the maximum soil concentration was used to compute the leaching rate for all the injection cells.

Based on the relatively small fraction of BTEX compounds remaining in the soil compared to that found in unweathered gasoline and the total concentration of TPH (Table 4.1), the residual LNAPL has been highly weathered. In order to simulate the higher rates of BTEX dissolution that occurred in the past, mass loading rates at the beginning of the model run were based on unweathered, fresh gasoline. The fraction of BTEX in the unweathered LNAPL was estimated from fresh gasoline fuels analysis data in the literature (Cline *et al.*,

1991; American Petroleum Institute, 1985); fresh gasoline has higher BTEX mass fractions than does the weathered LNAPL now present at the site. Mass loading rates at the end of the calibrated model run (present-day conditions) were based on the current highly weathered concentrations. The decreasing mass dissolution rates as the residual LNAPL weathered over time were estimated using a first-order decay constant. Use of a first-order constant was considered reasonable because the weathering of the residual LNAPL was assumed to consist qualitatively of both aerobic and anaerobic decay through vadose zone biodegradation as well as physical weathering and volatilization, and these processes were assumed to continue acting on the remaining fuel mass over time.

According to the partitioning coefficients that describe the relative solubility of each BTEX compound (see Appendix D), benzene had the fastest dissolution rate, followed by toluene, xylenes, and ethylbenzene, respectively. Appendix D contains the calculations for the residual LNAPL source term used for the groundwater model. The mass loading rate at the start of the model run (35 years before present) was estimated at approximately 1.23 milligrams per day per square foot (mg/day-ft$^2$) of BTEX contamination reaching groundwater from residual LNAPL contamination. The mass loading rate at the end of the calibrated model run model (present-day conditions) was estimated at approximately 0.0048 mg/day-ft$^2$ of BTEX. Summed over a suspected area of residual contamination of 6,000 square feet, the residual BTEX source loading for the entire UST Site varied from 7,400 mg/day to 28 mg/day for initial conditions and present-day conditions, respectively. The first-order decay constant was calculated at 0.00044 per day.

As mentioned in Section 5.3.3, residual LNAPL mass loading rates were simulated via injection wells in 15 grid cells in the Bioplume II model (Figure 5.1). The BTEX source loading rates in the preceding paragraph translate to concentrations of 40.1 mg/L per cell and 0.16 mg/L per cell at an injected flow rate of 5 x $10^{-6}$ cubic foot per second (cfs), and these concentrations were used as inputs in the model to simulate LNAPL dissolution for initial conditions and present conditions, respectively. The simulated BTEX loading rates used during each year of the model run are discussed in Section 5.6.1.

### 5.3.5 Anaerobic Degradation Rates

Available data strongly suggest that anaerobic degradation is occurring at the site. Combined anaerobic processes account for approximately 50 percent of the assimilative capacity of site groundwater (Table 4.6). Anaerobic degradation must therefore be simulated with Bioplume II to make meaningful predictions. The Bioplume II model simulates anaerobic biodegradation by assuming that such degradation follows first-order kinetics. As with a large number of biological processes, anaerobic biodegradation can be estimated using a first-order rate constant and the equation:

$$\frac{C}{C_0} = e^{-kt}$$

Where: $C$ = Contaminant Concentration at Time t

$C_0$ = Initial Contaminant Concentration

k = Coefficient of Anaerobic Decay (anaerobic rate constant)

t = time.

Two methods of calculating the anaerobic rate constants are currently available to quantify rates of biodegradation at the field scale and are applicable for use with available site data. The first method involves the use of a biologically recalcitrant compound found in the dissolved BTEX plume that can be used as a conservative tracer. The second method, proposed by Buscheck and Alcantar (1995), involves interpretation of a steady-state contaminant plume configuration and is based on the one-dimensional, steady-state analytical solution to the advection-dispersion equation presented by Bear (1979).

### 5.3.5.1 Trimethylbenzene/Tetramethylbenzene Tracer Method

In order to calculate anaerobic rate constants, the apparent degradation rate must be normalized for the effects of dilution caused by advective/dispersive processes and sorption. This can be accomplished by normalizing the concentration of each contaminant to the concentration of a component of gasoline (a tracer) that has similar sorptive properties but is fairly recalcitrant to biodegradation. Observed BTEX concentration data can be normalized to the TMB isomers 1,3,5-TMB, 1,2,4-TMB, and/or 1,2,3-TMB, tetramethylbenzene (TEMB), or to another tracer with similar physiochemical properties. The TMB and TEMB compounds can serve as good tracers because they can be recalcitrant under anaerobic conditions, and they have sorptive properties similar to the BTEX compounds (Cozzarelli *et al.*, 1990 and 1994). Thus, these compounds are assumed to respond similarly to the processes of advection, dispersion, and sorption without experiencing a reduction in concentration due to biodegradation.

The corrected concentration of a compound is the concentration of the compound that would be expected at one point (B) located downgradient from another point (A) after correcting for the effects of dispersion, dilution, and sorption between points A and B. One relationship that can be used to calculate the corrected contaminant concentration is:

$$C_{B,Corr} = C_B(TEMB_A/TEMB_B)$$

Where: $C_{B,Corr}$ = Corrected concentration of compound at Point B

$C_B$ = Measured concentration of compound at Point B

$TEMB_A$ = Measured TEMB (or TMB) concentration at Point A

$TEMB_B$ = Measured TEMB (or TMB) concentration at Point B.

A log-linear plot of the corrected contaminant concentrations versus the travel time from the origin can be used to determine whether the data set can be described using a first-order exponential equation [i.e., the coefficient of determination ($r^2$) is greater than approximately 0.9]. When this occurs, the exponential slope can be used as the anaerobic rate constant.

Application of the tracer method to the UST Site was not possible because of the age of the residual LNAPL contamination and its highly weathered state. The declining mass loading

rate has caused source area contaminant concentrations to fall below those farther downgradient. In addition, the close proximity of the large drainage channel as a groundwater discharge point, and the small size of the plume, did not allow for collection of sufficient data points along the section of flowpath with decreasing contaminant concentrations for the application of the tracer method.

### 5.3.5.2 Method of Buscheck and Alcantar

Buscheck and Alcantar (1995) derive a relationship that allows calculation of first-order decay rate constants for steady-state plumes. This method involves coupling the regression of contaminant concentration (plotted on a logarithmic scale) versus distance downgradient (plotted on a linear scale) to an analytical solution for one-dimensional, steady-state, contaminant transport that includes advection, dispersion, sorption, and biodegradation. For a steady-state plume, the first-order decay rate is given by (Buscheck and Alcantar, 1995):

$$\lambda = \frac{v_c}{4\alpha_x}\left(\left[1 + 2\alpha_x\left(\frac{k}{v_x}\right)\right]^2 - 1\right)$$

Where: $\lambda$ = first-order decay rate
$v_c$ = retarded contaminant velocity in the x-direction
$\alpha_x$ = dispersivity
$k/v_x$ = slope of line determined from a log-linear plot of contaminant concentration versus distance downgradient along flow path

The first-order decay rate includes biodegradation resulting from both aerobic and anaerobic processes; however, in the absence of oxygen, the first-order rate is equivalent to the anaerobic decay rate.

Application of the Buscheck and Alcantar method to the UST Site also was not possible for the same reasons discussed in Section 5.3.5.1. In addition, the plume must be at or close to a steady-state configuration for this method, which is unlikely to be the case at this site because of the limited BTEX source strength of the residual LNAPL and the recent compost pile influence on BOD and other geochemical parameters. Therefore, the anaerobic degradation rate also could not be estimated from field data using this method.

### 5.3.5.3 Selection of Anaerobic Decay Rate Constant

Because an anaerobic decay constant could not be determined from site field data, a review of recent literature was performed. Chapelle (1994) reported that at two different sites with anaerobic groundwater conditions, the anaerobic rate constants were both approximately 0.01 day$^{-1}$. Wilson *et al.* (1994) reported first-order anaerobic biodegradation rates of 0.05 to 1.3 week$^{-1}$ (0.007 to 0.185 day$^{-1}$); Buscheck *et al.* (1993) reported first-order attenuation rates in a range of 0.001 to 0.01 day$^{-1}$; and Stauffer *et al.* (1994) reported rate constants of 0.01 and 0.018 day$^{-1}$ for benzene and *p*-xylene, respectively.

An anaerobic rate constant of 0.00049 day$^{-1}$ was used as a starting value in the calibration of the Bioplume II model for this site. This rate is at the low end of values reported in the

literature and is the first-order decay constant used for an RNA study at a site at Travis AFB, California with similar geologic, hydrogeologic, and geochemical conditions (Parsons ES, 1996). This starting value was considered consistent with site conditions and also potentially conservative because a low anaerobic decay rate would result in less mass lost to anaerobic biodegradation.

## 5.4 MODEL CALIBRATION

Model calibration is an important component in the development of any numerical groundwater model. Calibration of the flow model demonstrates that the model is capable of matching hydraulic conditions observed at the site; calibration of a contaminant transport model superimposed upon the calibrated flow model helps verify that contaminant loading and transport conditions are being appropriately simulated. The numerical flow model presented herein was calibrated by altering transmissivity and constant-head boundary conditions in a trial-and-error fashion until simulated heads approximated observed field values within a prescribed accuracy. After calibration of the flow model, the numerical transport model was calibrated by estimating and adjusting solute loading and transport parameters in a trial-and-error fashion until the simulated BTEX plume approximated observed field values. Table 5.1 lists input parameters used for the modeling effort. Model input and output files are included in Appendix D.

### 5.4.1 Water Table Calibration

The groundwater at the UST Site was assumed to be influenced by continuous recharge and discharge at the constant-head cells within the model grid. The initial water levels at the constant-head cells and the transmissivity values were varied to calibrate the water table surface. The model was calibrated under steady-state flow conditions.

Hydraulic conductivity is an important aquifer characteristic that determines the ability of the water-bearing strata to transmit groundwater. Transmissivity is the product of the hydraulic conductivity and the thickness of the aquifer. An accurate estimate of hydraulic conductivity is important to help quantify advective groundwater flow velocities and to define the flushing potential of the aquifer and the quantity of electron-acceptor-charged groundwater that is entering the site from upgradient locations.

Saturated thickness data from previous reports, geologic logs, and water level measurements were used in conjunction with the hydraulic conductivity estimates from slug tests (see Sections 2.5 and 3.3.2.2) to create an initial transmissivity grid for the entire model. To better match heads in the model to observed values, the transmissivities were progressively varied in sections of the grid until the simulated water levels for cells corresponding to selected well locations matched the observed water levels as closely as possible. Figure 5.2 shows the calibrated water table.

The model was successfully calibrated using three hydraulic conductivities. In the area of the site where the slug tests were performed (MW-1) and for MPs which exhibited similar recharge rates, the average conductivity calculated from the slug tests ($8.8 \times 10^{-5}$ ft/s) was used. Upgradient from the site, the conductivity was doubled to $1.8 \times 10^{-4}$ ft/s to reproduce the gentler gradient and potentiometric surface. A lower hydraulic conductivity of $1.0 \times 10^{-5}$

# TABLE 5.1

## BIOPLUME II MODEL INPUT PARAMETERS
### UST SITES 10-494, 10-495, AND 10-496
### INTRINSIC REMEDIATION TS
### BEALE AFB, CALIFORNIA

| Parameter | Description | Calibrated Model (BEALECAL) | Predictive Model (BEALESW) |
|---|---|---|---|
| NTIM | Maximum number of time steps in a pumping period | 1 | 1 |
| NPMP | Number of Pumping Periods | 36 | 50 |
| NX | Number of nodes in the X direction | 20 | 20 |
| NY | Number of nodes in the Y direction | 30 | 30 |
| NPMAX | Maximum number of Particles: NPMAX= (NX-2)(NY-2)(NPTPND) + (Ns[a/])(NPTPND) + 250 | 5245 | 5245 |
| NPNT | Time step interval for printing data | 1 | 1 |
| NITP | Number of iteration parameters | 7 | 7 |
| NUMOBS | Number of observation points | 5 | 5 |
| ITMAX | Maximum allowable number of iterations in ADIP [b/] | 200 | 200 |
| NREC | Number of pumping or injection wells | 15 | 15 |
| NPTPND | Initial number of particles per node | 9 | 9 |
| NCODES | Number of node identification codes | 2 | 2 |
| NPNTMV | Particle movement interval (IMOV) | 0 | 0 |
| NPNTVL | Option for printing computed velocities | 0 | 0 |
| NPNTD | Option to print computed dispersion equation coefficients | 0 | 0 |
| NPDELC | Option to print computed changes in concentration | 0 | 0 |
| NPNCHV | Option to punch velocity data | 0 | 0 |
| NREACT | Option for biodegradation, retardation and decay | 1 | 1 |
| PINT | Pumping period ( years) | 1 | 1 |
| TOL | Convergence criteria in ADIP | 0.001 | 0.001 |
| POROS | Effective porosity | 0.25 | 0.25 |
| BETA | Characteristic length (long. dispersivity; feet) | 15 | 15 |
| S | Storage Coefficient | 0 (Steady-State) | 0 (Steady-State) |
| TIMX | Time increment multiplier for transient flow | - | - |
| TINIT | Size of initial time step (seconds) | - | - |
| XDEL | Width of finite difference cell in the x direction (feet) | 20 | 20 |
| YDEL | Width of finite difference cell in the y direction (feet) | 20 | 20 |
| DLTRAT | Ratio of transverse to longitudinal dispersivity | 0.1 | 0.1 |
| CELDIS | Maximum cell distance per particle move | 0.5 | 0.5 |
| ANFCTR | Ratio of Tyy to Txx (1 = isotropic) | 1 | 1 |
| DK | Distribution coefficient | 0.32 | 0.32 |
| RHOB | Bulk density of the solid (grams/cubic centimeter) | 1.65 | 1.65 |
| THALF | Half-life of the solute | - | - |
| DEC1 | Anaerobic decay coefficient (day$^{-1}$) | 0.00022 | 0.00022 |
| DEC2 | Reaeration coefficient (day$^{-1}$) | 0 | 0 |
| F | Stoichiometric Ratio of Hydrocarbons to Oxygen | 3.14 | 3.14 |

a/ Ns = Number of nodes that represent fluid sources (wells or constant head cells)

b/ ADIP = Alternating-direction implicit procedure (subroutine for solving groundwater flow equation)

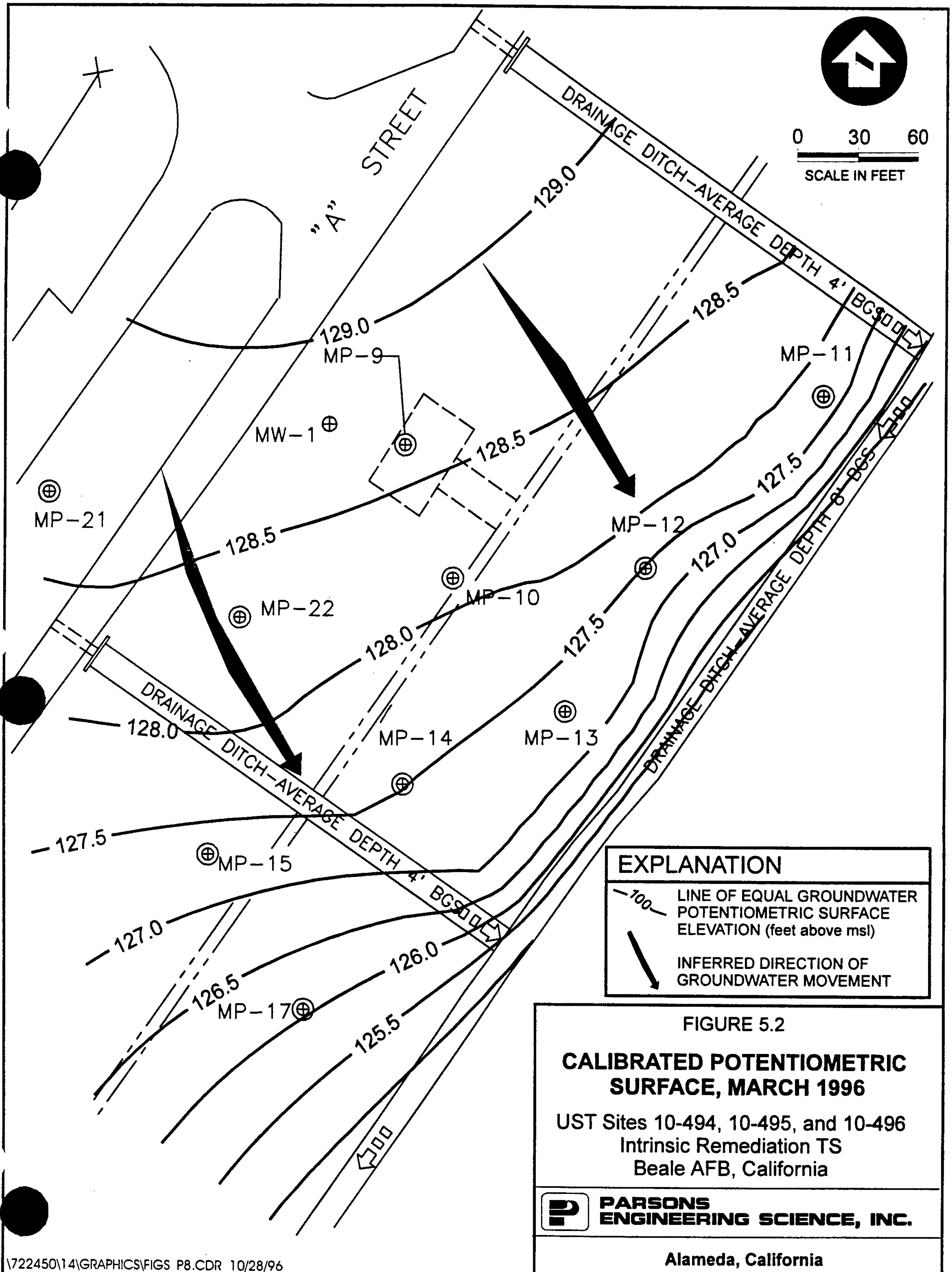



FIGURE 5.2

**CALIBRATED POTENTIOMETRIC SURFACE, MARCH 1996**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

ft/s was used in areas around MP-12, MP-15, and MP-17 where recharge rates were very low during MP sampling activities. The average aquifer thickness of 4.5 feet determined from borehole logs (Appendix A) was used across the entire model grid. Water level elevation data from cells associated with the 11 groundwater monitoring locations within the model grid were used to compare measured and simulated heads for calibration. The root mean square (RMS) error is commonly used to express the average difference between simulated and measured heads. RMS error is the average of the squared differences between measured and simulated heads and can be expressed as:

$$\mathrm{RMS} = \left[\frac{1}{n}\sum_{i=1}^{n}\left(h_m - h_s\right)_i^2\right]^{0.5}$$

Where: $n$ = the number of points where heads are being compared

$h_m$ = measured head value (feet above msl)

$h_s$ = simulated head value (feet above msl)

The RMS error between observed and calibrated values at the 11 comparison points was 0.243 foot, which corresponds to a calibration error of 9.1 percent. RMS error calculations are summarized in Appendix D. A plot of measured versus calibrated heads shows a random distribution of points around a straight line as shown in Appendix D. Deviation of points from a straight line should be randomly distributed in such a plot of results from computer simulations (Anderson and Woessner, 1992).

In solving the groundwater flow equation, Bioplume II establishes the water table surface and calculates an overall hydraulic balance that accounts for the numerical difference between flux into and out of the system. The hydraulic mass balance for the calibrated model was excellent, with greater than 99.99 percent of the water flux into and out of the system being accounted for numerically (a 0.0018 percent error). According to Anderson and Woessner (1992), a mass balance error of around 1 percent is acceptable, while Konikow (1978) indicates an error of less than 0.1 percent is ideal.

### 5.4.2 BTEX Plume Calibration

Model input parameters affecting the distribution and concentration of the simulated BTEX plume were modified so that model predictions matched dissolved total BTEX concentrations observed in March 1996. To do this, model runs were made using the calibrated steady-state hydraulic parameters coupled with the simulated introduction of contaminants at the injection wells.

Calibration of the fate and transport portion of a Bioplume II model generally requires that the contaminant distribution be known for at least two different times, one of which can be the initial release date. The time and volume of gasoline releases at the UST Site are not known; the USTs are simply known to have been removed prior to 1962.

For the initial model run, it was assumed that the mass loading from the residual LNAPL in soil began in 1961. Mass loading rates were then decreased for the following 35 years of the model run (until 1996) using first-order decay to simulate weathering of the residual LNAPL source as discussed in Section 5.3.4. The estimated BTEX loading rates were applied to the 15 simulated injection wells of the model grid to reproduce the dissolution of BTEX from the residual LNAPL. While the term "injection well" suggests contaminants are being introduced at a point, Bioplume II assumes that contamination introduced at a well instantly equilibrates throughout the entire cell in which the well is located. The injection rate for the cells was set at 5 x $10^{-6}$ cfs, a value low enough that the flow calibration and water balance were not affected.

Although it is likely greater sources of BTEX contamination existed prior to UST removal activities (e.g., mobile LNAPL or higher amounts of residual LNAPL in the soil that was removed), model runs indicated that any concentration of dissolved BTEX that was input at the beginning of the model run would be either completely degraded or discharged to the drainage channel over the 35 year period of the model run. Because the extent of contamination at the time of the UST removal action is not known and because the results of the model were not affected by any pre-existing dissolved BTEX contamination, no initial BTEX concentrations were input into the final calibrated model. Therefore, mass estimates included in the model output files do not account for any initial mass which may have been in the aquifer prior to UST removal activities.

In addition to the injection of BTEX, Bioplume II allows the DO concentration to be specified at the beginning of the model simulation for the entire model grid. Bioplume II also allows constant DO concentrations in the water entering the model grid from constant-head cells. At this site, the presence of the compost pile within the former excavation pit posed a significant difficulty in modeling DO concentrations. The compost pile likely generated significant BOD from its initiation after UST removal activities and its removal in November 1995. However, there is no capability in Bioplume II to model an oxygen sink (i.e., the compost pile) separately from the contaminant (i.e., BTEX) being investigated; therefore, the calibrated model was run assuming that no aerobic biodegradation occurred between 1961 and 1996 (i.e., the initial DO concentration and the water entering the model grid were assumed to have DO concentrations of 0 mg/L).

By excluding aerobic biodegradation, the model is conservative because only anaerobic biodegradation (a slower process) is included. However, a significant disadvantage of this approach is that upgradient and crossgradient from the plume, modeled BTEX concentrations will be overestimated. DO is likely reaching cross-gradient locations and would be expected to limit the width of the plume. More importantly, DO is also likely reaching the locations of residual LNAPL upgradient from the compost pile at concentrations high enough to stimulate biodegradation of the leaching BTEX, especially in later years as the BTEX concentrations decrease.

Plume calibration was performed over a 35-year simulation period (1961 to 1996). Computed BTEX plume concentrations and configurations were compared to March 1996 BTEX data after 35 years of simulation time incorporating injection, transport, and degradation of contaminants in groundwater. The calibrated plume is shown in Figure 5.3.

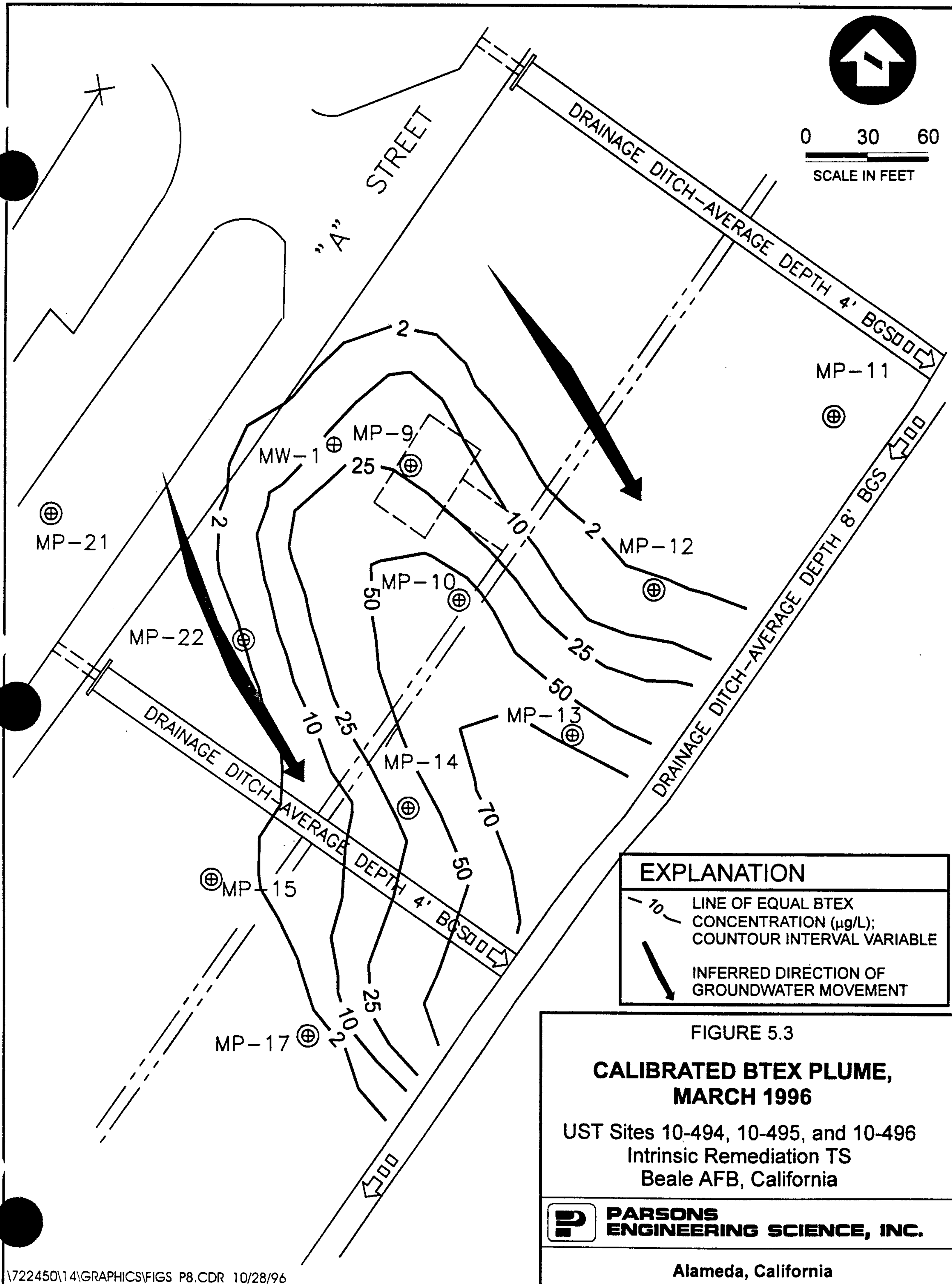



FIGURE 5.3

**CALIBRATED BTEX PLUME, MARCH 1996**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

The final calibrated model plume (year 35) was assumed to represent present-day (1996) conditions and compares favorably to the observed BTEX plume (Figures 4.1 and 5.3). As discussed above, the model overestimates the BTEX concentrations at upgradient (near MP-9 and MW-1) and crossgradient (near MP-12 and MP-17) locations.

The objective of the calibration was to achieve a modeled plume that equaled or exceeded the observed BTEX plume in terms of extent and concentration. The calibrated model successfully meets these objectives, as it reproduces both the observed areal extent of the plume and its contaminant concentrations. The calibrated BTEX plume accurately predicts a preferential flow of contamination toward MP-13 and MP-14 and the discharge into the large drainage channel.

The fact that the model concentrations in the source area and upgradient from the same area are slightly higher than observed concentrations means additional BTEX mass is accounted for in the model simulations and model predictions are conservative. Slight variations in shape between the model and the observed plume are likely due to subsurface heterogeneities in the hydraulic conductivity, reaeration coefficient, dispersivity, and retardation coefficient that are extremely difficult to identify in the field and to replicate in a discretized model domain.

### 5.4.2.1 Discussion of Parameters Varied During Plume Calibration

The transport parameters varied during plume calibration were dispersivity, the coefficient of retardation, and the coefficient of anaerobic decay. These parameters were generally varied with the intent of altering plume migration so that the observed plume extent was reproduced. While these parameters were varied with this common intent, each had a slightly different impact on the size and shape of the simulated plume.

#### *5.4.2.1.1 Dispersivity*

Much controversy surrounds the concepts of dispersion and dispersivity. Longitudinal dispersivity values for sediments similar to those found at the site range from 0.1 to 200 feet (Walton, 1988). Because longitudinal dispersivity is a function of scale, typically it is estimated based on the length of the contaminant plume. However, at this site the presence of the drainage channel limits the actual plume length. Therefore, the scale of observation used to estimate an initial dispersivity value was taken as twice the plume length (to include its mirror image across the channel). The longitudinal dispersivity was initially estimated at 5 feet, using approximately 1 percent (0.01) of twice the plume length of 240 feet.

During plume calibration, longitudinal dispersivity was varied between 5 and 25 feet. These values are relatively low compared to possible values cited in the literature (Walton, 1988). The use of low dispersivity values is a conservative estimate for modeling because low dispersivities cause less BTEX to be lost to dilution. The calibrated model uses a dispersivity of 15 feet. The ratio of transverse dispersivity to longitudinal dispersivity was maintained at 0.1 to help reproduce the plume width observed at the site.

*5.4.2.1.2 Coefficient of Retardation*

Retardation of the BTEX compounds relative to the advective velocity of the groundwater occurs when BTEX molecules are sorbed to organic carbon in the aquifer matrix. TOC analyses often are influenced by the presence of soil contamination, which may cause high soil TOC concentrations without necessarily reflecting an increase in the sorptive potential of soil. Therefore, TOC measurements used for retardation estimates should be taken from contaminant-free soils. Furthermore, TOC analysis should be taken across the phreatic surface rather than in the vadose zone to best represent the sorptive potential of saturated soils in the aquifer. The coefficients of retardation for the BTEX compounds were calculated based on measured TOC concentrations in the soils in and near the saturated zone at the site (Section 4.2.4), an assumed bulk density of 1.65 grams per cubic centimeter ($g/cm^3$) (Freeze and Cherry, 1979), and published values of the soil sorption coefficients ($K_{oc}$) for the BTEX compounds as listed by Wiedemeier *et al.* (1995). The results of these calculations are summarized in Table 5.2.

The lower the assumed coefficient of retardation, the farther the BTEX plume will migrate downgradient. A higher assumed coefficient of retardation leads to more mass being retained nearer the source. Because the residual LNAPL is highly weathered at the site and the majority of the BTEX components found were ethylbenzene and xylenes (Table 4.2), which have higher retardation coefficients than benzene and toluene, an average retardation coefficient for all BTEX components (R=3.14) was used initially during plume calibration. This initial value also was used for the final calibrated model. An analysis of the sensitivity of the calibrated model to the coefficient of retardation also was performed and is discussed in Section 5.5.

*5.4.2.1.3 Coefficient of Anaerobic Decay*

The coefficient of anaerobic decay is a first-order rate constant used in Bioplume II to simulate the rate of use and replenishment of anaerobic electron acceptors in the groundwater. A coefficient of anaerobic decay of 0.00049 $day^{-1}$ was originally estimated, based on literature values and the first-order decay rate calculated from a site at Travis AFB, California, as discussed in Section 5.3.5.3. Use of an anaerobic decay coefficient is justified at this site because anaerobic decay mechanisms account for approximately 50 percent of the assimilative capacity at the site. The coefficient of anaerobic decay had a significant effect on the magnitude of the concentrations within the center of the plume and also controlled the amount of contaminant mass reaching the drainage channel.

Through iterative variation of the anaerobic decay coefficient and other select model parameters, the model was calibrated to 1996 analytical data. An anaerobic decay constant of 0.00022 $day^{-1}$ provided the best calibration and was used in the final calibrated model. This value was approximately one-half of the starting value and probably provided a better fit to site data because anaerobic decay processes at the Travis site, upon which the starting value was based, included sulfate reduction and methanogenesis, which are not considered important processes at the UST Site. An analysis of the sensitivity of the calibrated model to the anaerobic decay constant also was performed and is discussed in Section 5.5.

# TABLE 5.2
# CALCULATION OF RETARDATION COEFFICIENTS
**UST Sites 10-494, 10-495, and 10-496**
**Intrinsic Remediation TS**
**Beale AFB, California**

| Compound | $K_{oc}$ [1] | Fraction Organic Carbon, $f_{oc}$ [2] | | | Distribution Coefficient $K_d$ (L/kg) | | | Bulk Density [1] | Effective | Retardation Coefficient, R | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (L/kg) | m | Minimum | Average | Maximum | Minimum | Average | (kg/L) | Porosity | Maximum | Minimum | Average |
| Benzene | 79 | 0.0022 | 0.00009 | 0.001145 | 0.17 | 0.007 | 0.090 | 1.65 | 0.25 | 2.15 | 1.05 | 1.60 |
| Toluene | 190 | 0.0022 | 0.00009 | 0.001145 | 0.42 | 0.017 | 0.22 | 1.65 | 0.25 | 3.76 | 1.11 | 2.44 |
| Ethylbenzene | 468 | 0.0022 | 0.00009 | 0.001145 | 1.0 | 0.042 | 0.54 | 1.65 | 0.25 | 7.80 | 1.28 | 4.54 |
| m-Xylene | 405 | 0.0022 | 0.00009 | 0.001145 | 0.89 | 0.036 | 0.46 | 1.65 | 0.25 | 6.88 | 1.24 | 4.06 |
| o-Xylene | 422 | 0.0022 | 0.00009 | 0.001145 | 0.93 | 0.038 | 0.48 | 1.65 | 0.25 | 7.13 | 1.25 | 4.19 |
| p-Xylene | 357 | 0.0022 | 0.00009 | 0.001145 | 0.79 | 0.032 | 0.41 | 1.65 | 0.25 | 6.18 | 1.21 | 3.70 |
| BTEX Compounds | | | | | 0.62 | 0.025 | 0.32 | | | 5.11 | 1.17 | 3.14 |

Notes:
[1] From technical protocol document (Wiedemeier et al., 1995)
[2] From site data
$K_d = f_{oc} \times K_{ow}$

## 5.5 SENSITIVITY ANALYSIS

The purpose of the sensitivity analysis is to determine the effect of varying model input parameters on model output. Based on the work of Rifai *et al.* (1988), the Bioplume II model is most sensitive to changes in the coefficient of aerobic decay (reaeration coefficient), the coefficient of anaerobic decay, and the hydraulic conductivity of the media and is less sensitive to changes in the retardation factor, porosity, and dispersivity. To evaluate the sensitivity of the calibrated model for the most sensitive parameters, the transmissivity (hence the hydraulic conductivity) and the coefficient of anaerobic decay were varied. In addition, a sensitivity analysis was performed for the retardation factor because of its effect on the amount of mass that potentially discharges into the drainage channel. Reaeration is assumed to be negligible at the site, and including it would only serve to make the model less conservative, so performing a sensitivity analysis was deemed unnecessary for this parameter.

To perform the sensitivity analyses, the calibrated model was adjusted by systematically changing the aforementioned parameters individually and then comparing the new model runs to the original calibrated model. The sensitivity models were run for a 35-year period (the same duration used to achieve plume calibration in the original model) to assess the independent effect of each variable. As a result, six sensitivity runs of the calibrated model were made using the following variations:

1. Transmissivity uniformly increased by a factor of 5;
2. Transmissivity uniformly decreased by a factor of 5;
3. Coefficient of anaerobic decay increased by a factor of 2;
4. Coefficient of anaerobic decay decreased by a factor of 2;
5. Coefficient of retardation increased by a factor of 2; and
6. Coefficient of retardation decreased by a factor of 2.

The results of the sensitivity analyses are shown graphically in Figures 5.4 through 5.6. These figures display the modeled BTEX concentrations versus distance along the centerline of the plume. This manner of displaying data is useful because BTEX concentrations are highest along the centerline and the plume is relatively symmetrical. Furthermore, the figures allow easy visualization of the changes in BTEX concentration caused by varying model input parameters.

The effects of varying transmissivity are shown on Figure 5.4. According to the work of Rifai *et al.* (1988), the Bioplume II model is particularly sensitive to variations in hydraulic conductivity. Higher values of hydraulic conductivity result in a faster-moving plume that may spread over a larger area and contains lower average BTEX concentrations. Lower values of hydraulic conductivity result in a slower-moving plume with a relatively small areal extent and higher average BTEX concentration.

Uniformly increasing the transmissivity by a factor of five significantly decreased the concentrations within the plume (by about one order of magnitude) due to the flushing effect

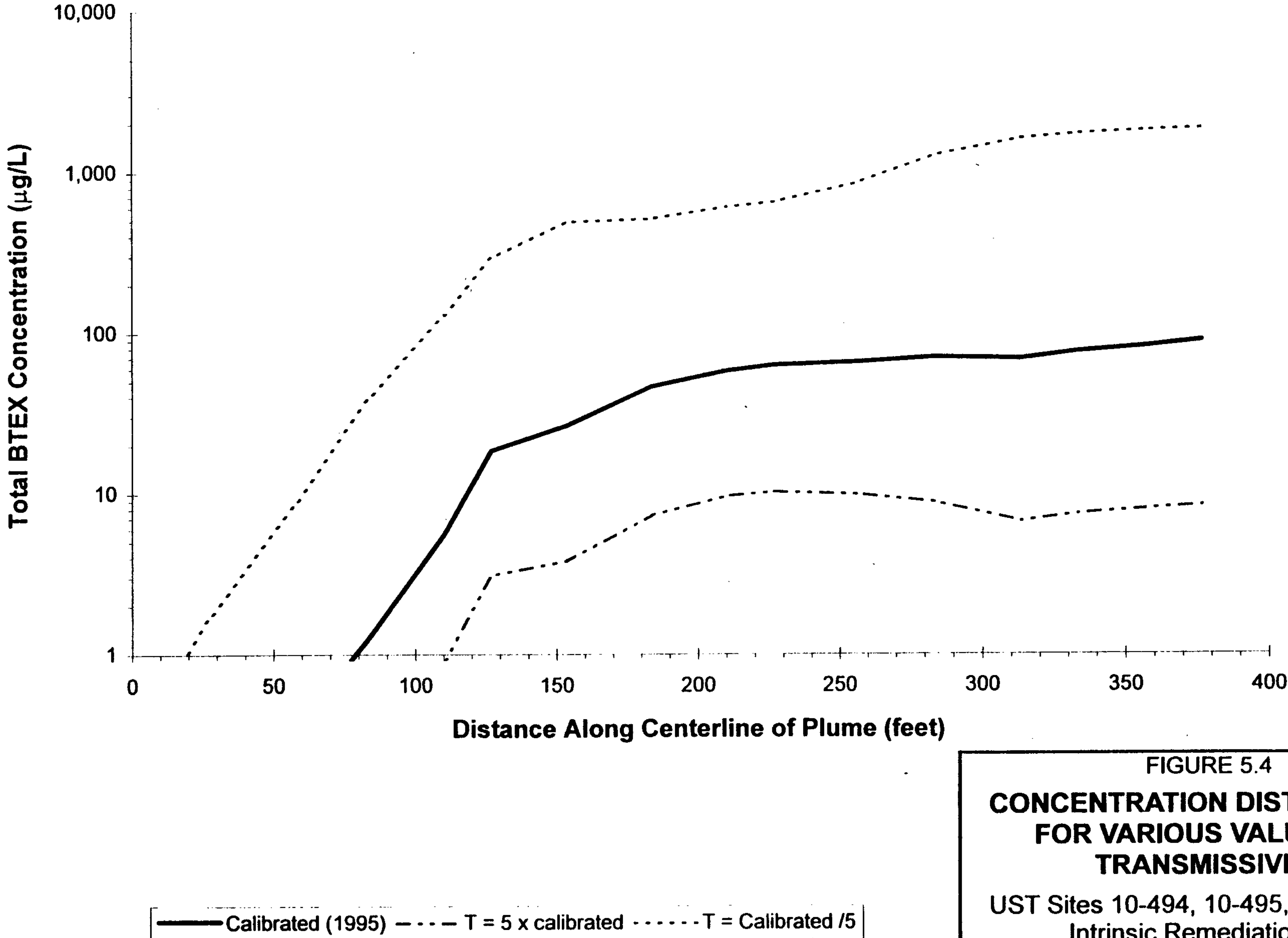



FIGURE 5.4

**CONCENTRATION DISTRIBUTION FOR VARIOUS VALUES OF TRANSMISSIVITY**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_L8.CDR 10/28/96

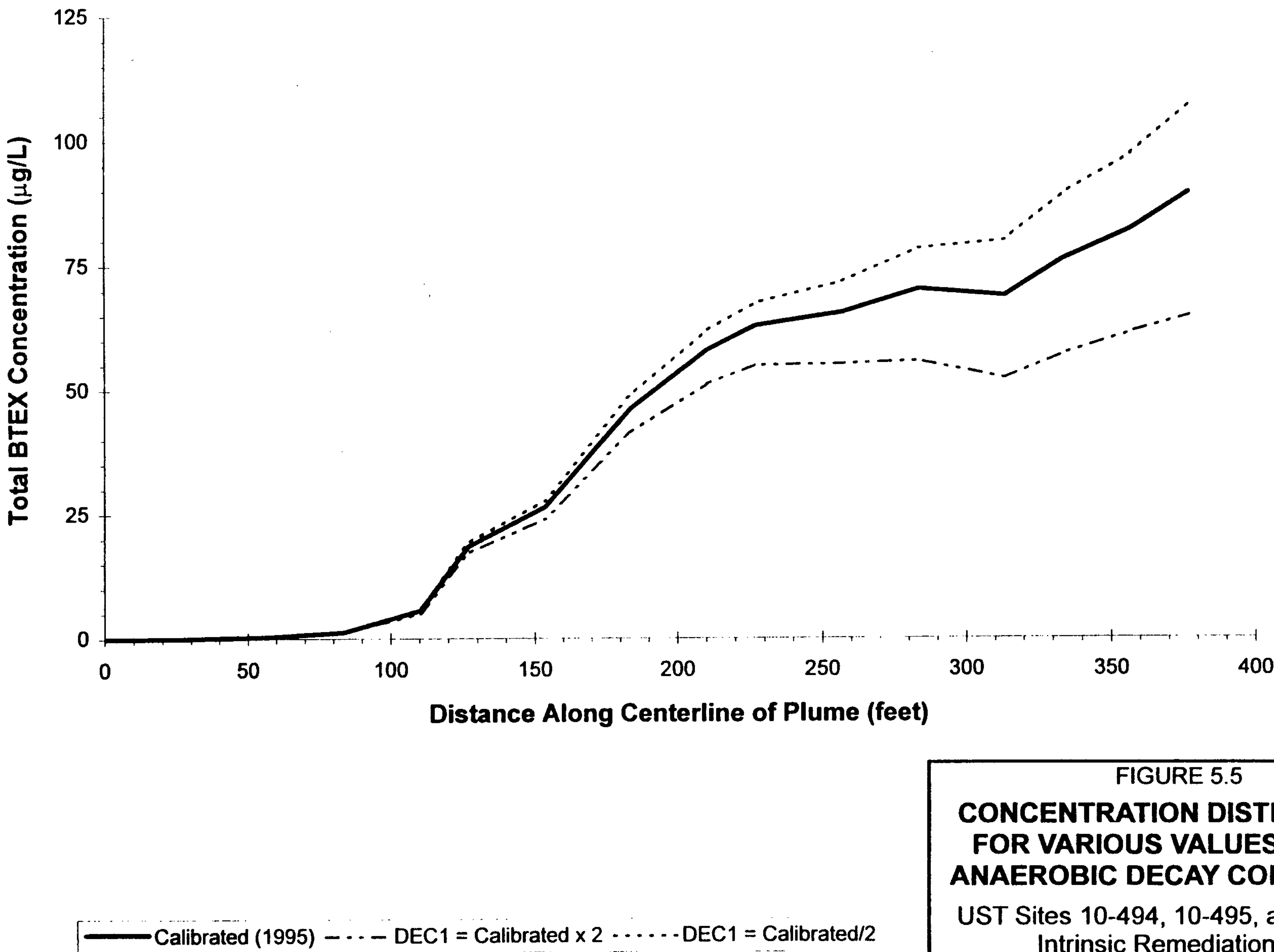



FIGURE 5.5

**CONCENTRATION DISTRIBUTION FOR VARIOUS VALUES OF THE ANAEROBIC DECAY COEFFICIENT**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_L8.CDR 10/28/96

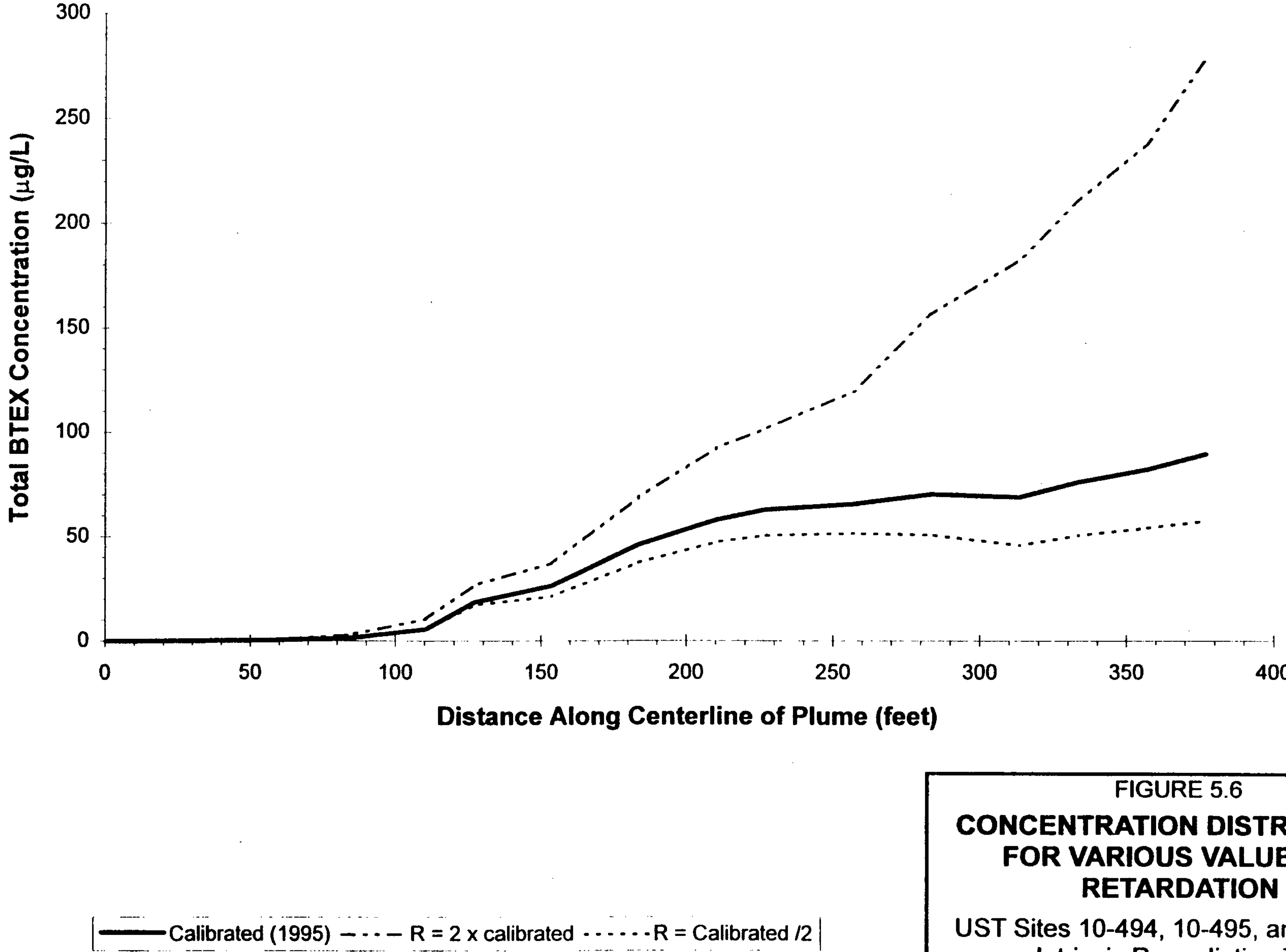



FIGURE 5.6

**CONCENTRATION DISTRIBUTION FOR VARIOUS VALUES OF RETARDATION**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Alameda, California**

\722450\14\GRAPHICS\FIGS_L8.CDR 10/28/96

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of faster groundwater velocities. The maximum concentration in the plume was only about 10 µg/L total BTEX, compared to the calibrated maximum of 89 µg/L. Mass balance estimates made by the model indicated that because of the faster travel times to the drainage channel, approximately 92 percent of the total mass leaving the system (the mass leached from the residual LNAPL minus the mass still stored in the aquifer) discharged into the drainage channel. The remaining 8 percent of the mass was degraded anaerobically. In comparison, mass balance estimates for the calibrated model indicated that 67 percent of the total mass leaving the system discharged to the drainage channel and 33 percent was degraded anaerobically.

In contrast, uniformly decreasing the transmissivity by a factor of five significantly increased the concentrations within the plume (by between one and two orders of magnitude) due to the much longer residence times of the contaminants in the aquifer. Mass balance estimates made by the model indicated that because of the longer residence times and higher concentrations, only 12 percent of the total mass leaving the system discharged into the drainage channel. The remaining 88 percent of the mass was degraded anaerobically (higher concentrations lead to higher anaerobic mass loss because the decay is a first-order process). Therefore, the model indicates a somewhat counterintuitive result: higher concentrations within the aquifer lead to less mass discharging into the drainage channel over time when compared with the calibrated model. However, this conclusion is only a result of the site-specific conditions used for this model run (i.e., the selected anaerobic decay rate, the selected mass loading rate, and the distance to the drainage channel) and should not be construed to be a general conclusion. One can easily visualize situations where higher concentrations, lower anaerobic decay rates, and high transmissivities could lead to significant discharge to a surface water body.

These results show that, as expected, the model is very sensitive to transmissivity, suggesting that reasonable values were used in the calibrated model.

Figure 5.5 shows the effects of varying the anaerobic decay coefficient. Increasing this parameter by a factor of two results in more rapid degradation of dissolved BTEX and lower concentrations with increasing distance from the source. Although the concentrations are not significantly different with more rapid degradation, mass balance estimates made by the model indicate that over the 35-year period of the model run, only 45 percent of the total mass leaving the system discharged into the drainage channel (compared to 67 percent for the calibrated model). The remaining 55 percent of the mass was degraded anaerobically. The relative differences in concentration and total mass removed are not substantially higher because, during the initial periods of the model run, concentrations are so high and the drainage channel is so close to the source that substantial amounts of mass still discharge into the channel. At the end of the model run, the concentrations are so low that the amount of mass removed anaerobically is relatively small.

Conversely, decreasing the anaerobic decay coefficient by a factor of two also decreases the rate of degradation, resulting in an increase in the estimate of mass discharged to the channel (approximately 82 percent) and in the computed maximum BTEX concentration (to approximately 110 µg/L). These results and the results discussed above show that the model

is only somewhat sensitive to the anaerobic decay coefficient with regard to concentration, and more sensitive to the anaerobic decay coefficient with regard to estimates of mass that discharge into the drainage channel. These results also indicate that reasonable values were used in the calibrated model.

The effects of varying the coefficient of retardation (R) are shown on Figure 5.6. Increasing R by a factor of 2 has a moderate effect on the contaminant concentration, while decreasing R by a factor of 2 only has a minor effect. An increase in sorptive capacity leads to a maximum BTEX concentration of 280 µg/L (compared to 89 µg/L for the calibrated model). As expected with higher concentrations and consistent with results discussed above for transmissivity changes, the mass of BTEX discharging to the drainage channel decreased from 67 percent for the calibrated model to 42 percent with the higher retardation coefficient.

The reason for the larger increase in concentration than decrease in concentration for the same change in the retardation coefficient is due primarily to the fact that the absolute value of the retardation factor cannot be less than one, and using a lower retardation factor simply means the contaminant velocity approaches the groundwater velocity. The retardation factor used for the calibrated model run was 3.14; decreasing it by a factor of 2 led to a retardation coefficient of 1.57, close to the limiting value of 1.

The results of the sensitivity analysis suggest that the calibrated model used for this report is reasonable. The calibrated model is most sensitive to transmissivity and slightly sensitive to the retardation coefficient and the anaerobic decay coefficient. Increasing the transmissivity greatly diminished the predicted BTEX concentrations, although the amount of mass discharged to the drainage channel also increased significantly. Lowering the values of transmissivity or increasing the retardation coefficient increased BTEX concentrations, but also increased the amount of mass anaerobically degraded and decreased the mass discharged into the drainage channel.

## 5.6 MODEL RESULTS

To predict fate and transport of dissolved BTEX compounds at the UST Site, the calibrated Bioplume II simulation (called BEALECAL) was run for a period of 50 years, 15 years beyond present-day conditions (Year 2011). This 50-year model run, called BEALESW (Beale Source Weathering), assumed the weathering of the residual LNAPL continued at the same first-order decay rate discussed in Section 5.3.4 and the degradation of dissolved BTEX contamination continued using the same anaerobic decay rate discussed in Section 5.4.2.1.3. The simulation assumed residual LNAPL will continue to exist at the site and no new removal actions or additional sources of BTEX will occur.

Table 5.3 shows the estimated reductions in BTEX loading rates applied to all years of the model run. These estimates are based on the calculations discussed in Section 5.3.4 and detailed in Appendix D. Input and output files for both the calibrated model and the source weathering model are provided on diskette in Appendix E.

Each of the injection periods assumes a BTEX injection rate lower than the previous period as a result of weathering using the first-order decay rate. To summarize, the weathering accounts for approximately 16 percent per year (%/yr) reductions in BTEX loading rates.

# TABLE 5.3
# ESTIMATED BTEX LOADING RATES FROM RESIDUAL LNAPL USED FOR MODEL RUNS
### UST Sites 10-494, 10-495, and 10-496
### Intrinsic Remediation TS
### Beale AFB, California

| Year | Model Period | BTEX Loading Rate (mg/day-ft$^2$) | BTEX Loading Rate (ug/L-cell) | Year | Model Period | BTEX Loading Rate (mg/day-ft$^2$) | BTEX Loading Rate (ug/L-cell) |
|---|---|---|---|---|---|---|---|
| 1961 | 1 | 1.2 | 40,100 | 1986 | 26 | 0.021 | 680 |
| 1962 | 2 | 1.0 | 34,070 | 1987 | 27 | 0.018 | 578 |
| 1963 | 3 | 0.88 | 28,940 | 1988 | 28 | 0.015 | 491 |
| 1964 | 4 | 0.75 | 24,590 | 1989 | 29 | 0.013 | 417 |
| 1965 | 5 | 0.64 | 20,890 | 1990 | 30 | 0.011 | 354 |
| 1966 | 6 | 0.54 | 17,750 | 1991 | 31 | 0.0092 | 301 |
| 1967 | 7 | 0.46 | 15,080 | 1992 | 32 | 0.0078 | 256 |
| 1968 | 8 | 0.39 | 12,810 | 1993 | 33 | 0.0066 | 217 |
| 1969 | 9 | 0.33 | 10,880 | 1994 | 34 | 0.0057 | 185 |
| 1970 | 10 | 0.28 | 9,240 | 1995 | 35 | 0.0048 | 157 |
| 1971 | 11 | 0.24 | 7,850 | 1996 | 36 | 0.0041 | 133 |
| 1972 | 12 | 0.20 | 6,670 | 1997 | 37 | 0.0035 | 113 |
| 1973 | 13 | 0.17 | 5,670 | 1998 | 38 | 0.0029 | 96 |
| 1974 | 14 | 0.15 | 4,810 | 1999 | 39 | 0.0025 | 82 |
| 1975 | 15 | 0.13 | 4,090 | 2000 | 40 | 0.0021 | 69 |
| 1976 | 16 | 0.11 | 3,470 | 2001 | 41 | 0.0018 | 59 |
| 1977 | 17 | 0.090 | 2,950 | 2002 | 42 | 0.0015 | 50 |
| 1978 | 18 | 0.077 | 2,510 | 2003 | 43 | 0.0013 | 43 |
| 1979 | 19 | 0.065 | 2,130 | 2004 | 44 | 0.0011 | 36 |
| 1980 | 20 | 0.055 | 1,810 | 2005 | 45 | 0.00095 | 31 |
| 1981 | 21 | 0.047 | 1,540 | 2006 | 46 | 0.00079 | 26 |
| 1982 | 22 | 0.040 | 1,310 | 2007 | 47 | 0.00067 | 22 |
| 1983 | 23 | 0.034 | 1,110 | 2008 | 48 | 0.00058 | 19 |
| 1984 | 24 | 0.029 | 943 | 2009 | 49 | 0.00049 | 16 |
| 1985 | 25 | 0.024 | 801 | 2010 | 50 | 0.00043 | 14 |

Notes:
1. Loading includes dissolution from residual LNAPL only (see Appendix D for calculation).
2. Loading does not account for sources which may have existed prior to UST removal (see Section 5.4.2).

Because the mass loading was modeled as a first-order process, mass loading into the aquifer is significantly higher during the initial periods of the model run, with approximately 90 percent of total BTEX removed from the total available mass in the first 15 years.

Using the conservative assumption that no aerobic decay occurs, over the 50-year period of the model run, approximately 67 percent of the mass leaving the system discharged to the drainage channel and 33 percent was degraded anaerobically. (Over the next 15 years, the model predicts that approximately 81 percent of the mass leaving the system will be discharged to the drainage channel and 19 percent will be degraded anaerobically.)

Based on the mass estimates made by the model, the amount of mass discharged to the drainage channel during 1995 was approximately 74 grams of BTEX. Using the estimated volumetric flow rate of water through the drainage channel of 2.5 cfs measured in March 1996, the estimated concentration of BTEX in the surface water would be less than 0.03 μg/L, well below the analytical detection limit for BTEX compounds. This rough calculation provides only an order of magnitude estimate but indicates that the amount of mass discharging into the channel at the current time is probably not significant enough to adversely impact surface water. This conclusion also is consistent with the analytical results for surface water samples, discussed in Section 4.3.1.1. Although the flow in the drainage channel would be lower in the summer months leading to possibly higher surface water concentrations, the hydraulic gradient at the site is also expected to be lower in the summer leading to a lower discharge rate, and the two effects could serve to counteract each other.

Figure 5.7 shows the modeled plume for 2006 and 2011, 45 and 50 years from the start of the model run, respectively, and 10 and 15 years from present-day, respectively. After 10 years, modeled BTEX contours decrease to approximately 15 percent of their current concentrations. Based on the ratio of benzene to total BTEX found at MP-14, in 2006 benzene would be only slightly above its California MCL of 1.0 μg/L. After 15 years, all areas of the plume are at or below 5 μg/L total BTEX. After 15 years, both TPH and BTEX constituents also would be expected to be below their taste and odor thresholds.

Because the model continues to assume that no DO will be present in the aquifer, it represents a worst-case scenario and not necessarily the expected future site conditions. The removal of the compost pile in November of 1995 may allow some concentration of DO to flow into the site and rapidly reduce current and future BTEX mass. Because all BTEX concentrations at the site are below 72 μg/L, only 230 μg/L (0.23 mg/L) of DO would be required to completely mineralize BTEX based on the stoichiometric relationships presented in Section 4.3.2.1. With an upgradient DO concentration potentially as high as 8.4 mg/L, even a small contribution from upgradient groundwater would be sufficient to biodegrade all remaining BTEX at the site.

These results suggest that, under even the worst-case scenario, the observed BTEX plume will continue to attenuate over the next 10 to 15 years, and all groundwater at the site should be below California MCLs within approximately 10 years and below taste and odor thresholds within approximately 15 years. Rates of mass discharge into the drainage channel do not appear to be high enough to significantly impact surface water. In addition, even if a relatively small concentration of DO is available at the site in the future due to the recent

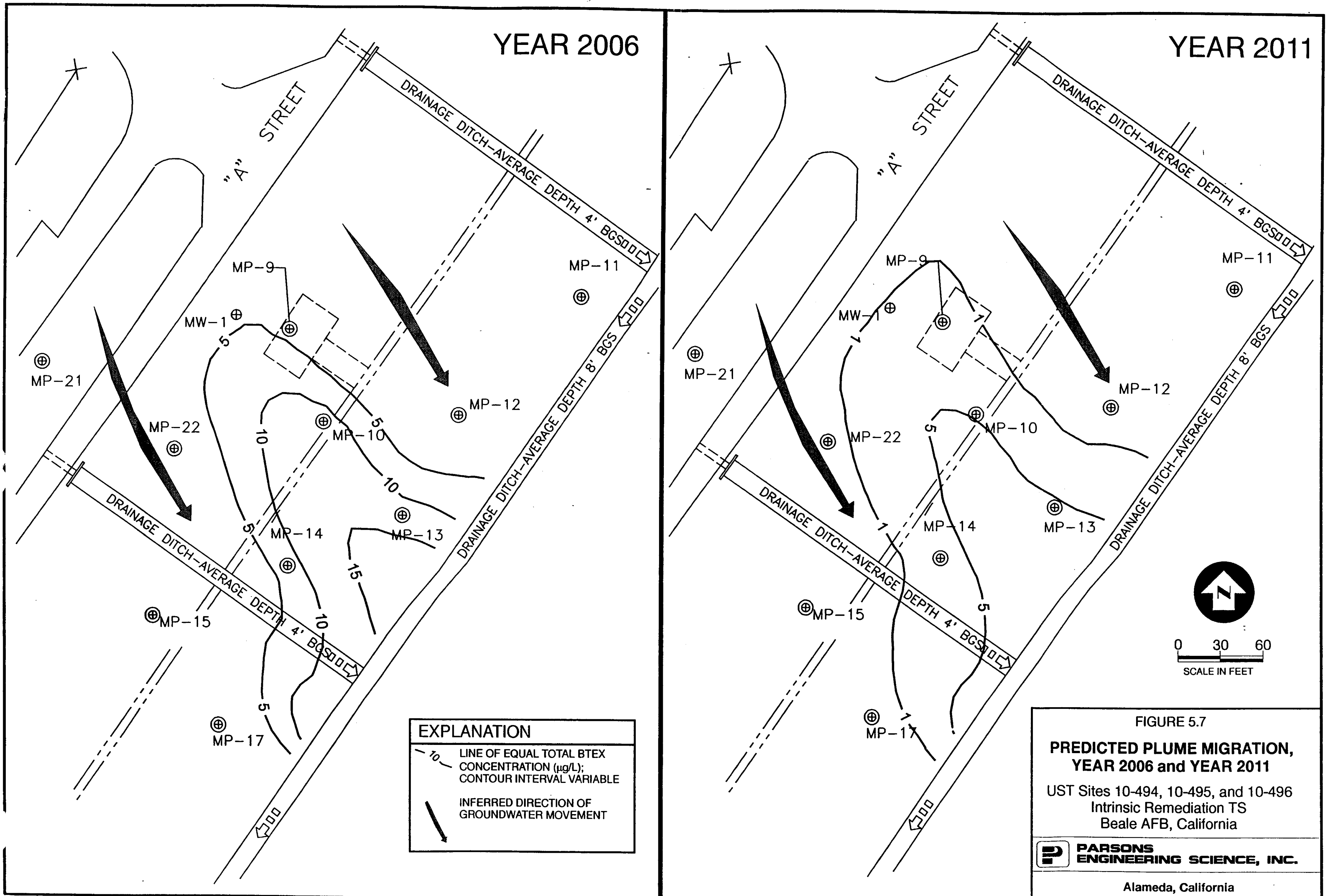


FIGURE 5.7

**PREDICTED PLUME MIGRATION, YEAR 2006 and YEAR 2011**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

Alameda, California

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removal of the compost pile, the plume would attenuate much more rapidly and California MCLs and taste and odor thresholds could be reached within only a few years or less.

## 5.7 CONCLUSIONS AND DISCUSSION

A single conservative model scenario was used to predict BTEX attenuation and migration rates at the UST Site. Model BEALESW assumed weathering of residual LNAPL in soil using a first-order decay rate and mass dissolution to groundwater through leaching and desorption. The first-order decay rate was calculated by assuming that residual LNAPL initially consisted of fresh gasoline that degraded over a 35-year period to the highest measured TPH and BTEX concentrations found at the site during the 1996 investigation. Only anaerobic processes were assumed to occur at the site due to the presence of a compost pile, which probably acted as a significant sink for DO in the aquifer in the past.

The model predicted that over the next 10 to 15 years, even without any influx of DO, California MCLs and taste and odor thresholds would be met at the site with no engineered remediation. In addition, the model predicts that the current and future rates of mass discharge into the drainage channel are not expected to be high enough to significantly impact surface water.

Several conservative assumptions are built into the model. The use of these conservative model assumptions suggests that natural attenuation of BTEX contamination at the site may exceed model predictions. These conservative model assumptions include:

1. Aerobic biodegradation was not included for future predictions. Although not including aerobic processes for model calibration was appropriate because of the compost pile, the compost pile has been removed and it can be expected that some DO will begin to enter the site over the next few years.

2. The anaerobic decay coefficient used in the calibrated model is lower than common literature values for BTEX.

3. The stoichiometry used to determine the ratio between electron receptors and total BTEX assumed that no microbial cell mass was produced during the reactions. As discussed in Section 4.3.2, this approach may be too conservative by a factor of three.

4. An average coefficient of retardation for all BTEX compounds was used in the model simulations (R=3.1). The majority of the BTEX contaminant mass at the site is composed of toluene, ethylbenzene, and xylenes (Table 4.2). Retardation coefficients for toluene, ethylbenzene, and xylenes may be significantly higher than 3.1 (as shown in Table 5.2), which will slow the migration of these compounds, thereby increasing their susceptibility to biodegradation.

5. The availability of electron acceptors at this site does not appear to be limiting. In fact, the compost pile appears to have been a source of nitrate and sulfate to the groundwater (Figures 4.4 and 4.6). Although sulfate reduction and methanogenesis were not included as possible electron acceptors at this site, the compost pile made

interpretation of the data difficult and inconclusive. Both sulfate reduction and methanogenesis may be occurring at the site.

6. Calibrated source concentrations in the models were somewhat higher than observed concentrations upgradient and crossgradient from the plume. This introduction of extra contaminant mass likely results in conservative predictions because additional BTEX mass must be biodegraded or discharged to the channel to produce the observed results.

The model simulation results demonstrate the potential for RNA to degrade the BTEX plume at the site without engineered source removal or treatment of the impacted medias. The patterns of degradation of the plume are feasible given the observed BTEX concentrations, the conservative assumptions made in constructing the simulation, and the strong evidence of biodegradation (Section 4).

# SECTION 6

# COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents the development and comparative analysis of groundwater remedial alternatives for the UST Site at Beale AFB. The intent of this evaluation is to determine if RNA of groundwater is an appropriate and cost-effective remedial approach to consider when developing final remedial strategies for the site.

Section 6.1 presents the criteria used to evaluate groundwater remedial alternatives. Section 6.2 discusses the development and comparative analysis of remedial alternatives considered as part of this demonstration project. Section 6.3 provides a description of the selected remedial alternative(s). Section 6.4 provides a more detailed evaluation of the selected remedial alternative(s) using the defined remedial alternative evaluation criteria.

## 6.1 REMEDIAL ALTERNATIVE EVALUATION CRITERIA

The evaluation criteria used to identify appropriate remedial alternatives for shallow groundwater contamination at the site were adapted from those recommended by the USEPA (1988) for selecting remedies for Superfund sites [Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-01]. These criteria included (1) long-term effectiveness and permanence, (2) technical and administrative implementability, and (3) relative cost. The following sections briefly describe the scope and purpose of each evaluation criterion. This report focuses on the potential use of RNA to reduce BTEX concentrations in the shallow groundwater to concentrations that meet regulatory action levels.

### 6.1.1 Long-Term Effectiveness and Permanence

Each remedial technology or remedial alternative (which can be a combination of remedial approaches and technologies such as RNA and institutional controls) was analyzed to determine how effectively it will minimize groundwater plume expansion so that groundwater quality objectives can be achieved at a POC. The expected technical effectiveness based on case histories from other sites with similar conditions also is evaluated. The ability to minimize potential impacts to surrounding facilities and operations is considered. Also, the ability of each remedial alternative to protect both current and potential future receptors from potential risks associated with potential exposure pathways is qualitatively assessed. This evaluation criterion also included permanence and the ability to reduce contaminant mass, toxicity, and volume. Time to implementation and time until protection is achieved are described. Long-term reliability for providing continued

protection, including an assessment of potential for failure of the technology and the potential threats resulting from such a failure, is also evaluated.

### 6.1.2 Implementability

The technical implementation of each remedial technology or remedial alternative was evaluated in terms of technical feasibility and availability. Potential shortcomings and difficulties in construction, operations, and monitoring are presented and weighed against perceived benefits. Requirements for any post-implementation site controls such as LTM and land use restrictions are described. Details on administrative feasibility in terms of the likelihood of public acceptance and the ability to obtain necessary approvals are discussed.

### 6.1.3 Cost

The total cost (adjusted to present worth) of each remedial alternative was estimated for relative comparison. An estimate of capital costs, and operating and post-implementation costs for site monitoring and controls is included. An annual adjustment factor of 7 percent was assumed in present worth calculations. The annual adjustment factor is the difference between the rate of inflation and the cost of money (USEPA, 1993).

## 6.2 FACTORS INFLUENCING ALTERNATIVES DEVELOPMENT

Several factors were considered during the identification and screening of remedial technologies for addressing shallow groundwater contamination at the site. Factors considered included the objectives of the AFCEE natural attenuation demonstration program; contaminant, groundwater, and soil properties; current and future land uses; and potential receptors and exposure pathways. The following section briefly describes each of these factors and how they were used to narrow the list of potentially applicable remedial technologies to the final remedial alternatives considered for the UST Site.

### 6.2.1 Program Objectives

The intent of the RNA demonstration program sponsored by AFCEE is to develop a systematic process for scientifically investigating and documenting natural subsurface attenuation processes that can be factored into overall site remediation plans. The objective of this program and the specific demonstration at the UST Site at Beale AFB is to provide solid evidence of RNA of dissolved fuel hydrocarbons so that this information can be used to develop an effective groundwater remediation strategy. A secondary goal of this multi-site initiative is to provide a series of regional case studies that demonstrate that natural processes of contaminant degradation can often reduce contaminant concentrations in groundwater to below acceptable cleanup standards before completion of potential receptor exposure pathways.

Because the objective of this program is to study natural processes in the saturated zone rather than all contaminated media (e.g., soil, soil gas, etc.), technologies have been evaluated based primarily on their potential impact on shallow groundwater and phreatic soils. Technologies that can reduce vadose zone contamination and partitioning of contaminants into groundwater also have been evaluated. Many of the source removal

technologies evaluated in this section also will reduce soil and soil gas contamination, but it is important to emphasize that the remedial alternatives developed in this document are not intended to remediate all contaminated media. Additional program objectives set forth by AFCEE include cost effectiveness and minimization of waste. Applicable technologies that may meet these criteria include institutional controls and RNA. Soil excavation, slurry walls, sheet piling, groundwater pump and treat, air sparging, carbon adsorption, *ex situ* biological or chemical treatment, and onsite/offsite disposal are not considered attractive technologies for this site.

### 6.2.2 Contaminant Properties

The site-related contaminants considered as part of this demonstration at the site are the BTEX compounds. The primary source of this contamination is petroleum (gasoline and possibly other fuels) leaked or spilled during past aboveground and underground fuel storage at the site. Residual contamination at the site is present in the capillary fringe and possibly in saturated soils. The physiochemical characteristics of the individual BTEX compounds will greatly influence the effectiveness and selection of a remedial technology.

Gasoline is classified as an LNAPL with a liquid density of approximately 0.73 g/cm$^3$ at 20°C (BEIA, 1989). Because gasoline is less dense than water, the LNAPL may become concentrated in the capillary fringe. Some of the individual gasoline constituents can either sorb to the soil matrix, dissolve into groundwater, or volatilize into soil vapor. Constituents in gasoline range from slightly to highly soluble in water. Overall solubility is approximately 300 mg/L. Gasoline is also a primary substrate for biological metabolism.

The BTEX compounds are generally volatile, highly soluble in water, and adsorb less strongly to soil than other hydrocarbons in a petroleum mixture. These characteristics allow the BTEX compounds to leach more rapidly from contaminated soil into groundwater, and to migrate as dissolved contamination (Lyman *et al.*, 1992). All of the BTEX compounds are highly amenable to *in situ* degradation by both biotic and abiotic mechanisms.

Benzene is very volatile, with a vapor pressure of 76 millimeters of mercury (mm Hg) at 20°C and a Henry's Law Constant of approximately 0.0054 atmosphere-cubic meters per mole (atm-m$^3$/mol) at 25°C (Hine and Mookerjee, 1975; Jury *et al.*, 1984). The solubility of pure benzene in water at 20°C has been reported to be 1,780 mg/L (Verschueren, 1983). Benzene is normally biodegraded to carbon dioxide, with catechol as a short-lived intermediate (Hopper, 1978; Ribbons and Eaton, 1992).

Toluene is also volatile, with a vapor pressure of 22 mm Hg at 20°C and a Henry's Law Constant of about 0.0067 atm-m$^3$/mol at 25°C (Pankow and Rosen, 1988; Hine and Mookerjee, 1975). Toluene sorbs more readily to soil media relative to benzene, but still is very mobile. The solubility of pure toluene in water at 20°C is approximately 515 mg/L at 20°C (Verschueren, 1983). Toluene has been shown to degrade to pyruvate, caetaldehyde, and completely to carbon dioxide via the intermediate catechol (Hopper, 1978; Wilson *et al.*, 1986; Ribbons and Eaton, 1992).

Ethylbenzene has a vapor pressure of 7 mm Hg at 20°C and a Henry's Law Constant of 0.0066 atm-m$^3$/mol (Pankow and Rosen, 1988; Valsaraj, 1988). Ethylbenzene sorbs more

strongly to soils than benzene and toluene (Kenaga and Goring, 1980; Means *et al.*, 1980; Hassett *et al.*, 1983; Fetter, 1993). Pure ethylbenzene is also less soluble than benzene and toluene in water at 152 mg/L at 20°C (Verschueren, 1983; Miller *et al.*, 1985). Ethylbenzene ultimately degrades to carbon dioxide via its intermediate 3-ethylcatechol (Hopper, 1978; Ribbons and Eaton, 1992).

The three isomers of xylene have vapor pressures ranging from 7 to 9 mm Hg at 20°C and Henry's Law Constants of between 0.005 and 0.007 atm-m$^3$/mol at 25°C (Mackay and Wolkoff, 1973; Hine and Mookerjee, 1975; Pankow and Rosen, 1988). A compilation of literature values for sorption coefficients suggests that xylenes sorb to soil with approximately the same strength as ethylbenzene (Wiedemeier *et al.*, 1995). Pure xylenes have water solubilities of 152 to 160 mg/L at 20°C (Bohon and Claussen, 1951; Mackay and Shiu, 1981; Isnard and Lambert, 1988). Xylenes can degrade to carbon dioxide via pyruvate carbonyl intermediates (Hopper, 1978; Ribbons and Eaton, 1992).

On the basis of these physiochemical characteristics, RNA, bioventing, soil vapor extraction, air sparging, biosparging, groundwater extraction, and air stripping technologies could all be effective options for collecting, destroying, and/or treating BTEX contaminants at the site. Some of these options are considered less desirable, however, after considering site-specific conditions.

### 6.2.3 Site-Specific Conditions

Three general categories of site-specific characteristics were considered when identifying remedial approaches for comparative evaluation as part of this demonstration. The first category was physical characteristics such as groundwater depth, hydraulic conductivity, gradient, flow direction, and soil type. The second category was the site geochemistry, or how the site contaminants are interacting with electron acceptors, microorganisms, and other site contaminants. Both of these categories influence the types of remedial technologies most appropriate for the site. The third category involved assumptions about future land use and potential receptor exposure pathways. Each of these site-specific characteristics have influenced the development of remedial alternatives included in the comparative evaluation.

#### 6.2.3.1 Physical Characteristics

Site geology and hydrogeology have a profound effect on the transport of contaminants and the effectiveness and scope of required remedial technologies at a given site. Hydraulic conductivity is perhaps the most important aquifer parameter governing groundwater flow and contaminant transport in the subsurface. The velocity of the groundwater and dissolved contamination is directly related to the hydraulic conductivity of the saturated zone. Estimated hydraulic conductivity values from the slug tests performed at MW-1 ranged from 5 to 8 ft/day, characteristic of sand or dirty sand (Freeze and Cherry, 1979).

Zones of lower conductivity at the site were inferred from the slow recharge of water into some of the monitoring points (MP-12, MP-15, MP-17, and MP-19). These zones were modeled with a hydraulic conductivity approximately one order of magnitude less than the values obtained from aquifer tests at MW-1 (Section 5.4.1, Appendix D). The location of these lower conductivity zones and the hydraulic connection between the shallow

groundwater and the large drainage channel east-southeast of the site have created a flow pathway that runs from the source area toward MP-13 and MP-14 (Figures 3.10 and 4.1).

Site geology and hydrogeology also impact the types of practical engineered remedial technologies. For example, engineered solutions to plume containment are simplified because the preferential flow pathway already provides partial plume containment. Furthermore, less expense and time should be required to capture and treat the contaminant plume using extraction wells in areas of higher hydraulic conductivity which characterize typical preferential flow pathways. The drainage channel also acts as a natural interception trench for groundwater. In addition, the effectiveness of biosparging may increase as hydraulic conductivity increases because of reduced entry pressures and an increased radius of influence. Contaminant recovery may also be maximized when contaminants are not significantly sorbed to and retarded by phreatic soil.

#### 6.2.3.2 Geochemical Characteristics

To satisfy the requirements of indigenous microbial activity and intrinsic bioremediation, the aquifer must also provide an adequate and available carbon or energy source (e.g., the contamination); electron acceptors; essential nutrients; and proper ranges of pH, temperature, and redox potential. Data collected as part of the fieldwork phase of this demonstration project and described in Sections 3 and 4 of this TS indicate that this site is characterized by adequate and available carbon/energy sources and electron acceptors to support measurable biodegradation of fuel hydrocarbon contamination by indigenous microorganisms. DO, ferric iron, and nitrate represent sources of electron acceptor capacity for the biodegradation of BTEX compounds at the site.

The average pH in shallow site groundwater is 6.8 and is within the optimal range for biodegradation of 6 to 8 standard pH units (Wiedemeier *et al.*, 1995). Fuel hydrocarbon-degrading microorganisms, however, have been known to thrive under a wide range of pH conditions (Chapelle, 1993). Groundwater data presented in Section 4 strongly support the conclusion that anaerobic biodegradation of BTEX is occurring at the site given the current geochemical conditions. Aerobic biodegradation should occur in the future with the removal of the compost pile.

Fuel-hydrocarbon-degrading microorganisms are ubiquitous, and as many as 28 hydrocarbon-degrading isolates (bacteria and fungi) have been discovered in different soil environments (Davies and Westlake, 1979; Jones and Eddington, 1968). Indigenous microorganisms have a distinct advantage over microorganisms injected into the subsurface to enhance biodegradation because indigenous microorganisms are well adapted to the physical and chemical conditions of the subsurface in which they reside (Goldstein *et al.*, 1985). Microbe addition was not considered a viable remedial technology for this site.

#### 6.2.3.3 Potential Receptor Exposure Pathways

An exposure pathways analysis identifies the potential human and ecological receptors that could come into contact with site-related contamination and the pathways through which these receptors might be exposed. To have a complete exposure pathway, there must be a source of contamination, a potential mechanism(s) of release, a pathway of transport to an

exposure point, an exposure point, and a receptor. If any of these elements do not exist, the exposure pathway is considered incomplete and receptors will not come into contact with site-related contamination.

Evaluation of the potential long-term effectiveness of any remedial technology or remedial alternative as part of this demonstration project includes determining the potential for pathway completion. If a completed exposure pathway exists (e.g., surface water contact), potential long-term remedial options may still be sufficient to maintain exposure concentrations below regulatory action levels. Establishing site-specific, risk-based cleanup levels is beyond the scope of this TS.

Assumptions about current and future land uses at a site form the basis for identifying potential receptors, potential exposure pathways, reasonable exposure scenarios, and appropriate remediation goals. USEPA (1991) advises that the land use associated with the highest (most conservative) potential level of exposure and risk that can reasonably be expected to occur should be used to guide the identification of potential exposure pathways and to determine the level to which the site must be remediated.

The State of California can impose stricter guidelines where deemed appropriate. At Beale AFB, both groundwater and surface water themselves are considered potential receptors because of their potential use as drinking water sources and in accordance with state non-degradation policies. Therefore, any recommended remedial actions should incorporate a timeframe for reaching appropriate remedial goals for groundwater and surface water throughout the site.

The contaminant source areas at the site consist of soils containing residual LNAPL immediately south and west of the former excavation pit. Shallow groundwater is expected to serve as the predominant release and transport mechanism. The majority of shallow groundwater at the site discharges to the large drainage channel east-southeast of the site. No discharge of fuel-contaminated groundwater into the channel has been observed. Access to the site is not restricted for Base personnel, workers, or on-Base residents. Public access to the site as well as the Base is restricted.

Although it is not within the scope of this demonstration, a risk assessment may be required to evaluate potential risks. It is possible that both human and ecological receptors could come into contact with fuel hydrocarbon contamination that discharges from the shallow groundwater into the surface water. However, interpretation of surface water analytical data, contaminant distribution maps, groundwater gradient maps, and the modeling mass balance estimates suggests that currently only a very small amount of dissolved BTEX migrates into the drainage channel. Therefore, the probability for exposure to human and ecological receptors is very low.

Assumptions about hypothetical future land, groundwater, and surface water uses also must be made to ensure that the remedial alternative considered for shallow groundwater at the site is adequate and sufficient to provide long-term protection. No changes in land use are anticipated in the foreseeable future, so the current land use assumptions are appropriate for future scenarios. Current groundwater regulatory policy of the RWQCB requires that all

groundwater at the site be considered a potential drinking water source. Therefore, the groundwater itself must be considered a potential receptor.

In summary, the use of the RNA technology at this site will require that restrictions on shallow groundwater use be enforced until BTEX and TPH concentrations are reduced below California MCLs and taste and odor thresholds throughout the site. Modeling results indicate that RNA technology can achieve these remedial goals for all site groundwater within a reasonable time period. Contractors and government workers must be informed of the existence of the BTEX and TPH plume and a suitable Health and Safety Plan should be in place to ensure onsite worker safety. Site workers also must be made aware of the proper storage and disposal procedures for contaminated groundwater and restriction on its use.

These controls would be required until any remedial activities and natural attenuation reduce contaminants to levels that pose no risk. Should LTM or any future sampling efforts demonstrate that the contamination is impacting the surface water or has moved across the eastern drainage channel, it may be necessary to re-evaluate the remedial alternatives selected. If source reduction technologies such as bioventing or biosparging are implemented, they will have some impact on the short- and long-term land use options and some level of institutional control and worker protection during remediation will be required.

#### 6.2.3.4 Remediation Goals for Shallow Groundwater

Model results suggest that BTEX and TPH compounds in shallow groundwater will naturally attenuate via biodegradation and that current discharges of contaminated groundwater to surface water are not significant. The selected remedial alternative(s) must be able to achieve groundwater concentrations protective of human health and the environment. The ultimate remedial objective for shallow groundwater is attainment of State of California surface water and groundwater quality objectives. California MCLs and taste and odor thresholds and federal MCLs are listed in Table 6.1 for dissolved fuel contaminants. Although it is unlikely that groundwater would be ingested by humans, California MCLs and taste and odor thresholds are currently the level of long-term protection required by The Water Quality Control Plan (Basin Plan) of the California Regional Water Quality Control Board (RWQCB), Central Valley Region (California RWQCB, 1994).

In summary, available data suggest that completed exposure pathways involving human and ecological receptors exposed to surface water may exist under current conditions. However, the probability for exposure of human and ecological receptors to significant contaminant concentrations is very low. A risk assessment for the surface water pathway may be required to evaluate risk from this pathway if future sampling indicates that BTEX contamination is reaching the surface water at detectable concentrations.

The data also suggest that there is no completed potential exposure pathway involving shallow groundwater, provided that use of shallow groundwater as a potable or industrial source of water is prohibited by institutional controls within approximately 500 feet of the UST Site. Thus, institutional controls are likely to be a necessary component of any groundwater remediation strategy for this site. The required duration of these institutional

controls may vary depending on the effectiveness of the selected remedial technology at reducing contaminant mass and concentrations in the groundwater.

**TABLE 6.1**

**WATER QUALITY OBJECTIVES**
**INTRINSIC REMEDIATION TS**
**UST SITES 10-494, 10-495, AND 10-496**
**BEALE AFB, CALIFORNIA**

| Compound | Federal MCLs [1] (μg/L) | California MCLs [2] (μg/L) | Taste & Odor Threshold [3] (μg/L) |
|---|---|---|---|
| Benzene | 5 | 1 | 170 |
| Toluene | 1,000 | 150 | 42 |
| Ethylbenzene | 700 | 700 | 29 |
| Xylenes (Total) | 10,000 | 1,750 | 17 |
| Total Petroleum Hydrocarbons as Gasoline (TPH-g) | no standard | no standard | 5 |

1 Drinking Water Regulations and Health Advisories, Office of Water, USEPA, May 1995.

2 California Code of Regulations (CCR), Title 22, Division 4, Chapter 15, Article 5.5, Section 64444, Maximum Contaminant Levels - Organic Chemicals.

3 Cal/EPA. 1998.

### 6.2.4 Summary of Remedial Option Screening and Analysis

Several remedial options have been identified for use in treating the shallow groundwater at the site. Among the initial remedial technologies and approaches considered as part of this demonstration were institutional controls, LTM, groundwater extraction/containment via vertical wells and/or interceptor trenches; air sparging; physical containment using slurry walls, grout curtains, or sheet piles; funnel and reactive gate walls; and RNA. Screening was conducted by considering the program objectives of the AFCEE RNA demonstration, physiochemical properties of the BTEX compounds, and other site-specific characteristics such as hydrogeology, geochemistry, land use assumptions, potential receptor exposure pathways, and appropriate remediation goals. All of these factors will influence the technical effectiveness, implementation, and relative cost of technologies for remediating shallow groundwater underlying and migrating from the site.

Based on the screening process (Table 6.2), a single remedial approach — RNA with LTM and institutional controls — was retained for development of the remedial alternative. The

# TABLE 6.2

## INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION

### UST Sites 10-494, 10-495, and 10-496
### Intrinsic Remediation Treatability Study
### Beale AFB, California

| General Response Action | Technology Type | Process Option | Implementability | Effectiveness | Relative Cost | Retain |
|---|---|---|---|---|---|---|
| Long-Term Monitoring | Periodic Groundwater/ Surface Water Monitoring | Confirmation Wells | Sufficient space exists between the source and within the plume for an additional well to confirm the progress of remediation. | Necessary for all remediation strategies | Low | Yes |
| | | Point-of-Compliance | A sufficient location exists downgradient of the plume at the drainage channel to perform surface water sampling. This location will need to be monitored to confirm that it is not impacted in the future. | Necessary | Low | Yes |
| Institutional Controls | Groundwater Use Control | Land Use Control/Regulate Well Permits | The plume lies within the base boundary, and land and groundwater use are under base jurisdiction. | Necessary | Low | Yes |
| | | Seal/Abandon Existing Wells | No production wells are known to exist in the current or predicted plume area. | Not required at this site | Low | No |
| | | Point-of-Use Treatment | No shallow groundwater is extracted from the plume area for any use. | Poor | Moderate | No |
| | Public Education | Meetings/ Newsletters | Base public relations and environmental management offices have many information avenues to workers and residents. | Necessary | Low | Yes |
| Containment of Plume | Hydraulic Controls | Interceptor Trench Collection | No likely receptors downgradient of site. Treatment of extracted water would probably be necessary. | Low | Moderate to High | No |
| | | Minimum Pumping/ Gradient Control | No likely receptors downgradient of site. Treatment of extracted water would probably be necessary. | Low | High | No |
| | Physical Controls | Slurry Walls/Grout Curtains | Limited effectiveness and costly. | Low | High | No |
| | | Sheet Piling | Limited effectiveness and costly. | Low | High | No |
| | Reactive/Semi-Permeable Barriers | Biologically Active Zones | Degration of BTEX can be stimulated by allowing groundwater to flow through a nutrient-rich barrier. Although implementable, the technology is new and unproven. | Moderate | High | No |

**Table 6.2 (continued)**

| General Response Action | Technology Type | Process Option | Implementability | Effectiveness | Relative Cost | Retain |
|---|---|---|---|---|---|---|
| *In Situ* Groundwater Treatment | Biological | Oxygen and/or Nutrient Enhanced Biodegradation (Biosparging) | Nutrients/Oxygen are injected downgradient of plume to limit plume migration by enhancing biodegradation and reducing BTEX concentrations. Although implementable, the technology is not proven to be more effective than intrinsic remediation. In addition, DO is likely to be recharged naturally upgradient of plume at sufficent quantities in the future. | Moderate | Low | No |
| | Chemical/ Physical | Intrinsic Remediation | A combination of natural biological, chemical, and physical removal mechanisms which occur to varying degrees on every site. Groundwater sampling at UST Site indicates that this is an ongoing remediation process. | High | Low | Yes |
| | | Air Sparging (Volatilization) | Injection of air into contaminated aquifer creating a mass transfer of BTEX into air bubbles and vadose zone. May be difficult to implement due to near surface, low permeability layer. | Low | Moderate | No |
| Aboveground Groundwater Treatment | Groundwater Extraction | Vertical Pumping Wells | Groundwater is pumped by installing submersible pumps in wells within or downgradient of plume. Could reduce the length of time required for natural attenuation processes to complete the groundwater restoration. | Moderate | Moderate | No |
| | Biological | Bioreactors | High flow rates require excessive retention times and large reactors. BTEX is often volatilized in these systems. | Moderate | High | No |
| | Chemical/ Physical | Air Stripping | Cost-effective technology for removing BTEX from groundwater at high flow rates. Difficult to permit. | High | Moderate | No |
| | | Activated Carbon | Implementable at the low BTEX concentrations at the UST Site, but requires disposal of carbon. | Moderate | High (O&M) | No |
| | | UV/Ozone Reactors | High flow rates require excessive retention times and large, expensive reactors. | Moderate | High | No |
| | Direct Discharge | Direct Discharge to Industrial Waste Water Treatment Plant (IWWTP) | Implementable option only when an IWWTP is readily available and capable of handling BTEX, TPH, and hydraulic loading. IWWTP not available for this site. | High | Low | No |

**Table 6.2 (continued)**

| General Response Action | Technology Type | Process Option | Implementability | Effectiveness | Relative Cost | Retain |
|---|---|---|---|---|---|---|
| Disposal | Sanitary Sewer | Sanitary Sewer | Implementable option when access to a sanitary sewer exists and loading is acceptable. Loading likely not acceptable to Base water treatment plant. | High | Low | No |
| | Treated Groundwater Reinjection | Vertical Injection Wells | Injection wells subject to clogging, high maintenance, and will be difficult to permit; aquifer is confined and/or semi-confined. | Moderate | Moderate | No |
| | | Injection Trenches | Requires large trenches and will be difficult to permit. | Moderate | Moderate | No |
| | Discharge to Surface Waters | | Generally requires NPDES or other discharge permit; not a viable option based on discussions with RWQCB. | High | Low | No |
| Source Removal/Soil Remediation | Excavation/ Treatment | Landfilling | Implementable at existing Base soils treatment facility but excavation is expensive and gravelly soils may pose problem for treatment facility. Dewatering and treatment/disposal of groundwater might be required. | Moderate | High | No |
| | | Biological Landfarming | Implementable at existing Base soils treatment facility but excavation is expensive and gravelly soils may pose problem for treatment facility. | Moderate | Moderate | No |
| | | Thermal Desorption | More costly than existing Base soils treatment facility. | Moderate | High | No |
| | *In Situ* | Bioventing | Air injection/extraction to increase soil oxygen levels and stimulate biodegradation of fuel residuals. Limited effectiveness at UST Site due to near surface low permeability layer and shallow contamination and groundwater. | Low to High | Low | No |
| | | Soil Vapor Extraction | Limited effectiveness at UST Site due to near surface low permeability layer and shallow contamination and groundwater. | High | Low to Moderate | No |
| | | Soil Washing | Water and/or surfactant solution are forced through zones of residual contamination to enhance contaminant partitioning into the groundwater. Most effective in homogeneous sandy soils. May cause increased concentrations to discharge to surface water. | Low | High | No |

screening process provided sufficient support to select the optimal remedial alternative based on the available site characterization data; thus, a detailed comparative analysis was unnecessary. However, should additional site characterization activities or LTM indicate that an RNA strategy is not protective of surface water or that the contaminant concentrations in groundwater are not decreasing at the rates expected by the modeling results presented in Section 5, then a more detailed feasibility study should be performed.

## 6.3 DESCRIPTION OF THE SELECTED REMEDIAL ALTERNATIVE — REMEDIATION BY NATURAL ATTENUATION AND INSTITUTIONAL CONTROLS WITH LONG-TERM GROUNDWATER AND SURFACE WATER MONITORING

Remediation by natural attenuation (RNA) is achieved when natural attenuation mechanisms bring about a reduction in the total mass of a contaminant in the soil or dissolved in groundwater. RNA results from the integration of several subsurface attenuation mechanisms that are classified as either destructive or nondestructive. Destructive attenuation mechanisms include biodegradation, abiotic oxidation, and hydrolysis. Nondestructive attenuation mechanisms include sorption, dilution (caused by dispersion and infiltration), and volatilization. In some cases, RNA will reduce dissolved contaminant concentrations below numerical concentration goals intended to be protective of human health and the environment. As indicated by the evidence of RNA described in Section 4, these processes are occurring at the UST Site and will continue to reduce contaminant mass in the plume area.

Model BEALESW is intended to predict the fate and transport of dissolved BTEX compounds if engineered remedial action is not implemented at the site. To accomplish this, the model assumes a weathered source of BTEX in the shallow aquifer. Results suggest that the dissolved BTEX plume will decrease in concentration over time. The model conservatively predicts that the TPH and BTEX plume will be reduced to concentrations below groundwater quality objectives within approximately 15 years.

Implementation of RNA would require the use of institutional controls such as land use restrictions and well permit regulation until the groundwater quality objectives are attained. Land use restrictions may include placing long-term restrictions on soil excavation within the source area and recreational facilities (i.e., playgrounds). Restrictions on groundwater well installations within and downgradient from the plume area would also be required until groundwater quality objectives are achieved. The intent of these restrictions would be to reduce potential receptor exposure to contaminants by legally restricting activities within areas expected to be affected by site-related contamination. Since modeling results indicate that RNA could achieve groundwater quality objectives in a reasonable time period, institutional controls for groundwater would be temporary and would be expected to be removed within a reasonable timeframe. The combination of limited institutional controls, RNA, and a groundwater monitoring program is expected to be protective of future unrestricted groundwater uses.

LTM would be conducted annually as part of this remedial technology to evaluate the progress of natural attenuation processes. LTM includes two types of monitoring locations. Long-term monitoring wells are intended to determine if the behavior of the plume is changing and to monitor the progress of contaminant reductions at the site. POC monitoring locations are intended to detect contaminant movement outside the negotiated perimeter of containment and to trigger an action to manage the risk associated with such expansion if the contaminant concentrations at POC locations exceed the water quality objectives listed in Table 6.1.

As a part of the interim LTM plan for this site, groundwater and surface water monitoring would be performed at three groundwater monitoring wells and three surface water sampling locations (discussed in Section 7). Both groundwater monitoring wells and surface water sampling locations would be used as POC locations for this site. Groundwater monitoring wells would be used to evaluate changes in contaminant concentrations and ensure that the plume does not expand or migrate. Surface water sampling locations would be used to ensure that discharges into surface water do not exceed water quality objectives at any time. Both the groundwater and surface water POC locations will be used to determine if more active remediation methods are warranted.

As part of the interim LTM plan, monitoring well locations would be chosen to monitor upgradient groundwater geochemistry and the contaminant plume between the source area and the drainage channel at the location where the highest benzene and total BTEX concentrations were found during this study (MP-14). The surface water locations would be chosen in the large drainage channel. One location would be upgradient from the site, one location would be where the plume appears to discharge into the channel, and one location would be downgradient from the site. Additional details (including more detailed monitoring locations) for interim LTM of groundwater and surface water at the site are provided in Section 7.2. If implementation of the remedial alternative does not result in a decrease in dissolved contaminant concentrations within the predicted time frame or additional site characterization activities alter the site conceptual model presented in this report, additional corrective action may be necessary, and land use restrictions would require reevaluation.

Public education on the selected alternative should be developed to inform Base personnel and residents of the scientific principles underlying RNA. This education could be accomplished through debriefings, presentations, and posting of signs where appropriate. Periodic site reviews could also be conducted every year using data collected from the long-term groundwater monitoring program. The purpose of these periodic reviews would be to evaluate the extent of contamination, assess contaminant migration and attenuation through time, document the effectiveness of institutional controls at the site, and reevaluate the need for additional remedial actions at the site.

## 6.4 EVALUATION OF THE SELECTED REMEDIAL ALTERNATIVE — REMEDIATION BY NATURAL ATTENUATION AND INSTITUTIONAL CONTROLS WITH LONG-TERM GROUNDWATER AND SURFACE WATER MONITORING

### 6.4.1 Effectiveness

Section 5 of this document presents the results of the Bioplume II modeling of RNA at the UST Site. Model BEALESW assumes that site remediation relies entirely on natural attenuation mechanisms. Results of the model suggest that 33 percent of the dissolved BTEX can be removed from the groundwater system through natural attenuation, with the remaining 67 percent of the mass discharging to the drainage channel but not at measurable concentrations. Model results conservatively indicate that after 15 years, the dissolved BTEX concentrations in site groundwater would be less than or equal to 5 µg/L. Based on the model results, the evidence of significant anaerobic biodegradation in the shallow groundwater (Section 4), and the potential for significant future aerobic biodegradation, RNA is an effective method to complete the restoration of site groundwater.

The effectiveness of this remedial alternative requires that excavations or drilling within the source area be conducted only by properly protected site workers. Long-term land use restrictions would be required to ensure that shallow groundwater is not pumped or removed for potable use within a radius of approximately 500 feet from the plume area. Existing health and safety plans should be enforced to reduce risks from additional excavation or from installing and monitoring additional wells.

Compliance with program goals is one component of the long-term effectiveness evaluation criterion. This alternative would satisfy program objectives designed to promote RNA as a component of site remediation and to scientifically document natural chemical attenuation processes. This alternative also satisfies program goals for cost effectiveness and waste minimization.

The RNA alternative is based on the effectiveness of natural processes that minimize contaminant migration and reduce contaminant mass over time and on the effectiveness of institutional controls. As described earlier, model results indicate that the BTEX plume will be contained and reduced within the source area via anaerobic biodegradation and future aerobic biodegradation. Therefore, the effectiveness of RNA with LTM and long-term institutional controls is favorable.

### 6.4.2 Implementability

RNA is not technically difficult to implement. Installation of monitoring wells and monitoring of groundwater and surface water are standard procedures. Long-term management efforts would be required to ensure proper sampling procedures are followed. Periodic site reviews should be conducted to confirm the adequacy and completeness of LTM data and verify the effectiveness of this remediation approach. There may also be administrative concerns associated with long-term enforcement of groundwater use restrictions. Future land use within the source area may be impacted by leaving contaminated soil and groundwater in place. Regulators would have to be informed of the

benefits and limitations of the RNA option. Educational programs for Base personnel and residents are not difficult to implement. Where the effectiveness of this option has been supported, the initial regulatory reaction to this alternative has been positive.

### 6.4.3 Cost

The cost of RNA with the proposed interim LTM plan is summarized in Table 6.3. Capital costs are limited to the construction of two new monitoring wells. Included in the approximately $104,000 total present worth cost estimate are the costs of maintaining institutional controls and long-term groundwater and surface water monitoring for a total of 15 years. Detailed cost calculations and assumptions are provided in Appendix F. Should additional site characterization activities or LTM indicate that an RNA strategy is not protective of surface water or that the contaminant concentrations in groundwater are not decreasing at the rates expected by the modeling results presented in Section 5, then a cost analysis comparison with more active remediation technologies should be performed.

**TABLE 6.3**

**RNA WITH LTM ALTERNATIVE - COST ESTIMATE**
**UST SITES 10-494, 10-495, AND 10-496**
**INTRINSIC REMEDIATION TS**
**BEALE AFB, CALIFORNIA**

| **Capital Costs** | **Cost** |
|---|---|
| Design/Construct 2 LTM Wells | $5,920 |
| **Monitoring Costs (per Sampling Event)** | **Cost per Event** |
| Conduct Groundwater/Surface Water Sampling at 6 locations (per event) (quarterly for first year and annually thereafter for 15 years) | $3,340 |
| Maintain Institutional Controls/Public Education (15 years) | $5,000 |
| Project Management and Reporting (15 years) | $1,100 |
| **Present Worth of Alternative 1[a/]** | **$103,880** |

a/ Based on an annual adjustment factor of 7 percent (USEPA, 1993).

Present worth costs and calculations are detailed in Appendix F.

# SECTION 7

# LONG-TERM MONITORING PLAN

## 7.1 OVERVIEW

At the UST Site, LTM is a required component of the selected remedial alternative discussed in Section 6; therefore, a long-term groundwater monitoring plan must be developed. The purpose of the LTM component of the selected remedial alternative is to assess site conditions over time, confirm the effectiveness of the remedial alternative, assess compliance with regulatory cleanup goals, and evaluate the need for additional remediation. The LTM plan consists of identifying groundwater and surface water sampling locations and developing a sampling and analysis strategy to demonstrate attainment of site-specific RAOs. The strategy described in this section is designed to assess the effectiveness of the remedial alternative through measurement of the reduction of contaminant mass and the rate of groundwater remediation. In the event that data collected under this LTM program indicate that the implemented remedial alternative is insufficient to achieve regulatory levels considered to be protective of human health and the environment at the POC locations, additional engineered controls to augment the beneficial effects of RNA may be necessary.

## 7.2 GROUNDWATER MONITORING WELLS

An interim LTM plan is currently proposed for the UST Site based on the available site characterization data. This interim LTM plan would need to be updated if results from additional site characterization activities significantly change the current conceptual model for the site (e.g., if the groundwater plume is determined to have migrated east of the large drainage channel or if seasonal sampling of the surface water indicates that surface water contaminant concentrations are above water quality goals).

As part of the interim LTM plan, it is recommended that three groundwater monitoring wells be utilized at the site — MW-1 and two new wells (MW-3 and MW-4). The new wells should be fully screened across the shallow saturated zone between approximately 5 and 15 feet bgs to allow comparison with results from MW-1. The presence of free product/mobile LNAPL should be evaluated during installation of MW-3 and removed to the extent practicable in compliance with regulatory requirements. The proposed LTM well locations are shown on Figure 7.1. The location of MW-3 was chosen near MP-13 and MP-14, where the highest concentrations of BTEX and benzene were found during this investigation. The well is downgradient from the residual LNAPL source area along the preferential flowpath to the groundwater discharge point at the drainage channel. The location for MW-1 was chosen to continue to assess the upgradient electron acceptor conditions at the site. The location for

MW-4 was chosen to provide additional site characterization data on the east side of the large drainage channel, to establish hydraulic control for the site, and to verify plume stability.

## 7.3 SURFACE WATER SAMPLING LOCATIONS

Three surface water locations should be utilized at the site as part of the interim LTM. The proposed locations are shown on Figure 7.1 (SW-1 through SW-3). One location would be upgradient from the site, one location would be where the plume appears to discharge into the channel, and one location would be downgradient from the site.

The purpose of these locations is to verify that no contaminated surface water exceeding water quality objectives (Table 6.1) migrates from the site and beyond the area under institutional control.

## 7.4 GROUNDWATER AND SURFACE WATER SAMPLING

To ensure that sufficient contaminant removal is occurring to meet site-specific remediation goals, the long-term groundwater and surface water monitoring plan includes a comprehensive SAP. The groundwater and surface water locations should be monitored for BTEX and TPH-g to assure that the selected remedy is providing the anticipated level of risk reduction and remediation at the site. Results from the LTM locations will be used to verify that naturally occurring processes are effectively reducing contaminant mass and mobility. Reductions in toxicity will be implied by mass reduction and compliance with numerical RAOs.

### 7.4.1 Sampling Frequency

Because the results of this study are based on a single monitoring event, groundwater and surface water elevation measurements should be collected quarterly for at least one year to determine seasonal variations in groundwater flow direction and gradient at the site. Groundwater and surface water samples from the LTM wells and surface water locations also should be collected quarterly for the first year to determine if there are any significant seasonal variations in contaminant concentrations. Assuming there are no significant seasonal variations, sampling frequency should be reduced to annually after the first year. The LTM wells and surface water locations should be sampled annually until the plume disappears (estimated at no more than 15 years based on the modeling results discussed in Section 5). If the data collected during this time period support the effectiveness of the selected remedial alternative at this site (e.g., the plume disappears), it may be possible to reduce or eliminate sampling. If the data collected at any time during the monitoring period indicate the need for additional remedial activities at the site, sampling frequency should be adjusted accordingly.

### 7.4.2 Analytical Protocol

The proposed LTM wells should be sampled and analyzed to determine compliance with chemical-specific remediation goals and to verify the effectiveness of naturally-occurring remediation processes at the site. At the beginning of each sampling event, water levels and presence of free product/mobile LNAPL should be measured at all site monitoring wells and

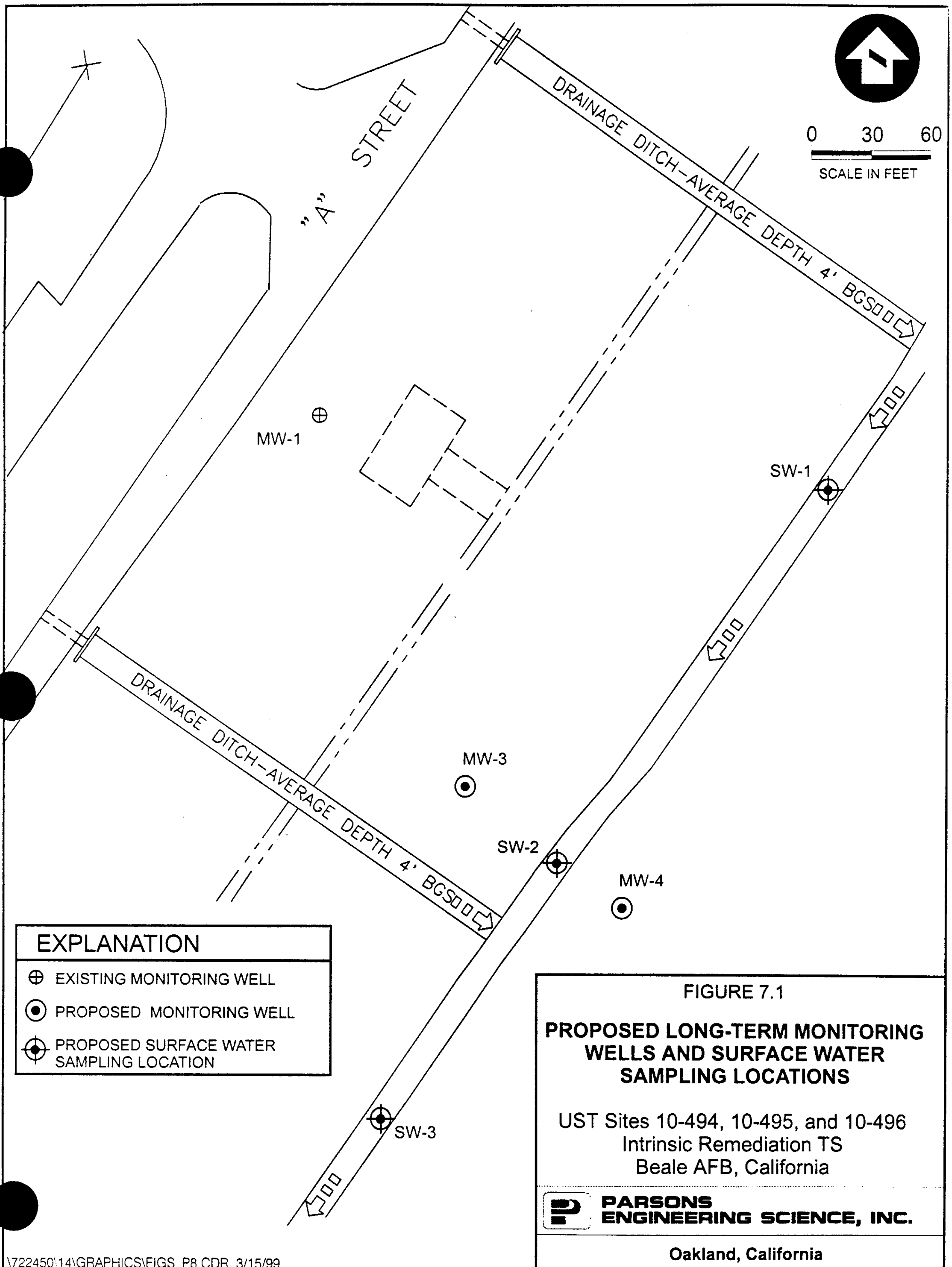


FIGURE 7.1

**PROPOSED LONG-TERM MONITORING WELLS AND SURFACE WATER SAMPLING LOCATIONS**

UST Sites 10-494, 10-495, and 10-496
Intrinsic Remediation TS
Beale AFB, California

**PARSONS ENGINEERING SCIENCE, INC.**

**Oakland, California**

in the surface water ditches. Groundwater samples collected from the LTM wells should be analyzed for the parameters listed in Table 7.1. Surface water samples should be analyzed for BTEX, TPH-g, DO, and temperature using the same analytical methods listed in Table 7.1. A site-specific groundwater SAP should be prepared prior to initiating the LTM program.

## TABLE 7.1

## LONG-TERM MONITORING ANALYTICAL PROTOCOL FOR GROUNDWATER
## UST SITES 10-494, 10-495, AND 10-496
## INTRINSIC REMEDIATION TS, BEALE AFB, CALIFORNIA

| Analysis | Method/Reference | Comments | Data Use | Recommended Frequency of Analysis | Sample Volume, Sample Container, Sample Preservation | Field or Fixed-Base Laboratory |
|---|---|---|---|---|---|---|
| Ferrous ($Fe^{+2}$) | Colorimetric A3500-Fe D | Field only | May indicate an anaerobic degradation process due to depletion of oxygen, nitrate, and manganese | Quarterly for first year; annually thereafter for 15 years | Collect 100 mL of water in a glass container; acidify with hydrochloric acid per method | Field |
| Ferrous ($Fe^{+2}$) | Colorimetric HACH 25140-25 | Alternate method; field only | Same as above | Quarterly for first year; annually thereafter for 15 years | Collect 100 mL of water in a glass container | Field |
| Temperature | E170.1 | Field only | Metabolism rates for microorganisms depend on temperature | Quarterly for first year; annually thereafter for 15 years | N/A | Field |
| Dissolved Oxygen | Dissolved oxygen meter | Refer to method A4500 for a comparable laboratory procedure | The oxygen concentration is a data input to the Bioplume model; concentrations less than 1 mg/L generally indicate an anaerobic pathway | Quarterly for first year; annually thereafter for 15 years | Collect 300 mL of water in biochemical oxygen demand bottles; analyze immediately; alternately, measure dissolved oxygen *in situ* | Field |
| pH | E150.1/SW9040, direct reading meter | Protocols/ Handbook methods | Aerobic and anaerobic processes are pH-sensitive | Quarterly for first year; annually thereafter for 15 years | Collect 100–250 mL of water in a glass or plastic container; analyze immediately | Field |
| Redox potential | A2580 B | Measurements are made with electrodes; results are displayed on a meter; samples should be protected from exposure to atmospheric oxygen | The redox potential of groundwater influences and is influenced by the nature of the biologically mediated degradation of contaminants; the redox potential of groundwater may range from more than 200 mV to less than -400 mV | Quarterly for first year; annually thereafter for 15 years | Collect 100–250 mL of water in a glass container, filling container from bottom; analyze immediately | Field |

## TABLE 7.1 (continued)

| Analysis | Method/Reference | Comments | Data Use | Recommended Frequency of Analysis | Sample Volume, Sample Container, Sample Preservation | Field or Fixed-Base Laboratory |
|---|---|---|---|---|---|---|
| Conductivity | E120.1/SW9050, direct reading meter | Protocols/ Handbook methods | General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system | Quarterly for first year; annually thereafter for 15 years | Collect 100–250 mL of water in a glass or plastic container | Field |
| Nitrate ($NO_3^{-1}$) | IC method E300 or method SW9056; colorimetric, method E353.2 | Method E300 is a Handbook method; method SW9056 is equivalent procedure | Substrate for microbial respiration if oxygen is depleted | Quarterly for first year; annually thereafter for 15 years | Collect up to 40 mL of water in a glass or plastic container; cool to 4°C; analyze within 48 hours | Fixed-base |
| Aromatic hydrocarbons (BTEX) | SW8021 | Handbook method; analysis may be extended to higher molecular weight alkyl benzenes | BTEX, are the primary target analyte for monitoring natural attenuation; BTEX concentrations must also be measured for regulatory compliance | Quarterly for first year; annually thereafter for 15 years | Collect water samples in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH 2 | Fixed-base |
| Total Petroleum Hydrocarbons as gasoline (TPH-g) | SW8015B | Handbook method | Data used to monitor the reduction in concentrations of total fuel hydrocarbons (in addition to BTEX) | Quarterly for first year; annually thereafter for 15 years | Collect water samples in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH 2 | Fixed-base |

**NOTES:**

1. "HACH" refers to the HACH Company catalog, 1990.
2. "A" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th edition, 1992.
3. "E" refers to *Methods for Chemical Analysis of Water and Wastes*, U.S. Environmental Protection Agency, March 1979.
4. "Protocols" refers to the AFCEE *Environmental Chemistry Function Installation Restoration Program Analytical Protocols*, 11 June 1992.
5. "Handbook" refers to the AFCEE *Handbook to Support the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS)*, September 1993.
6. "SW" refers to the *Test Methods for Evaluating Solid Waste, Physical, and Chemical Methods*, SW-846, U.S. Environmental Protection Agency, 3rd edition, Final Update III, December 1996.
7. "ASTM" refers to the *American Society for Testing and Materials*, current edition.
8. "RSKSOP" refers to *Robert S. Kerr (Environmental Protection Agency Laboratory) Standard Operating Procedure.*
9. "LUFT" refers to the state of California *Leaking Underground Fuel Tank Field Manual*, 1988 edition.

# SECTION 8

# CONCLUSIONS AND RECOMMENDATIONS

This report presents the results of a TS conducted to evaluate the use of RNA with LTM for remediation of fuel-hydrocarbon-contaminated groundwater at the UST Site at Beale AFB, California. Specifically, the finite-difference groundwater model Bioplume II was used in conjunction with site-specific geologic, hydrologic, and laboratory analytical data to simulate the migration and biodegradation of fuel hydrocarbon compounds dissolved in groundwater. To collect the data necessary for the RNA demonstration, Parsons ES scientists collected soil, groundwater, and surface water samples from the site. Physical and chemical data collected under this program were supplemented (where necessary) with data collected during previous site characterization events.

Comparison of BTEX, TPH-g, electron acceptor, and biodegradation byproduct isopleth maps for the UST Site provides strong qualitative evidence of biodegradation of BTEX and TPH-g compounds. Geochemical data strongly suggest that biodegradation of fuel hydrocarbons is occurring at the site via the anaerobic processes of nitrate reduction and iron reduction. Aerobic biodegradation also is likely to occur in the near future due to recent changes in site conditions. Patterns observed in the distribution of hydrocarbons, electron acceptors, and biodegradation byproducts further indicate that biodegradation is reducing contaminant concentrations in site groundwater. Surface water data indicate that groundwater discharging to the drainage channel is not resulting in detectable surface water concentrations of these chemicals.

Site-specific geologic, hydrologic, and laboratory analytical data were used in the Bioplume II numerical groundwater model to simulate the effects of advection, dispersion, sorption, contaminant loading, and biodegradation on the fate and transport of the contaminant plume. Extensive site-specific data were used for model calibration and implementation. Model parameters that could not be obtained from existing site data were estimated using widely accepted literature values for soils similar to those found at the site. Conservative aquifer parameters were used to construct the Bioplume II model for this study, and, therefore, the model results presented herein may represent a worst-case scenario.

For the model simulation (BEALESW), it was assumed that weathering of the source areas would persist for the duration of the simulation. Model results conservatively indicate that after 15 years, the dissolved BTEX concentrations in groundwater would be less than or equal to 5 µg/L. Based on the model results, the evidence of significant anaerobic biodegradation in the shallow groundwater (Section 4), and the potential for significant future aerobic biodegradation, RNA with LTM is an effective method to complete the restoration of site groundwater.

The results of this study suggest that RNA of BTEX and TPH-g compounds is occurring at the site and intrinsic bioremediation should ensure protection of human health and the environment. Therefore, the Air Force recommends that RNA, LTM, and institutional controls be implemented at the site. Institutional controls such as restrictions on shallow groundwater use and protective equipment for onsite workers during future drilling or excavation activities would prevent completion of exposure pathways while site remediation is in progress.

To verify the results of the Bioplume II modeling effort and to ensure that the selected remediation is progressing at rates sufficient to meet objectives, groundwater from three LTM wells should be sampled and analyzed for the parameters listed in Table 7.1. The surface water locations should be analyzed for BTEX, TPH-g, DO, and temperature by the methods listed in Table 7.1.

Figure 7.1 shows suggested locations for the interim LTM groundwater monitoring wells for surface water sampling. The presence of free product/mobile LNAPL should be evaluated during installation of any new LTM well(s) and removed to the extent practicable in compliance with regulatory requirements. Because of the removal of the compost pile near the source area at this site, the groundwater geochemistry can be expected to change within the next few years. Therefore, it is recommended that the assimilative capacity of site groundwater be reevaluated during LTM.

The LTM plan presented in Section 7 of this report will serve as an interim LTM until installation of the LTM wells and completion of the first year of sampling. The interim LTM wells and surface water locations should be sampled quarterly for the first year. Thereafter, the LTM should be updated as necessary and sampling should be reduced to annually if no significant seasonal changes in groundwater flow direction and gradient and contaminant concentrations are measured. Sampling should continue until the BTEX and TPH-g concentrations fall below regulatory levels of concern (estimated at 10 to 15 years). Sampling could decrease in frequency if the plume disappears, as dictated by the analytical results. If any BTEX or TPH-g concentrations detected in surface water exceed the water quality objectives or concentrations in groundwater are increasing significantly greater than that predicted by modeling results, additional corrective actions and comparative cost analyses may be required to remediate groundwater at the site.

# SECTION 9

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# APPENDIX A

# BOREHOLE LOGS, MONITORING POINT AND WELL CONSTRUCTION SUMMARY

# MONITORING POINT AND WELL CONSTRUCTION SUMMARY
## UST Sites 10-494, 10-495, and 10-496
## Intrinsic Remediation TS
## Beale AFB, California

| Location | Date Completed | Material | Diameter (inches) | Total Depth (feet bgs) | Screened Interval (feet bgs) | Sand Pack Interval [a] (feet bgs) | Bentonite Interval (feet bgs) | Grout Interval (feet bgs) |
|---|---|---|---|---|---|---|---|---|
| MP-01 | 3/1/96 | PVC | 0.50 | 9.75 | 4.75 - 9.75 | 3.5 - 9.75 | 0.0 - 3.5 | -- |
| MP-03 | 2/29/96 | PVC | 0.50 | 8.8 | 3.8 - 8.8 | 3.0 - 8.8 | 0.0 - 3.0 | -- |
| MP-08 | 2/27/96 | SS | 0.50 | 17.0 | 16.5 - 17.0 | -- | 0.0 - 16.0 | -- |
| MP-09 | 2/27/96 | PVC | 0.50 | 10.5 | 5.0 - 10.0 | 3.0 - 10.0 | 0.0 - 3.0 | -- |
| MP-10 | 2/28/96 | PVC | 0.50 | 10.5 | 4.0 - 9.0 | 3.0 - 10.5 | 0.0 - 3.0 | -- |
| MP-11 | 2/28/96 | PVC | 0.50 | 10.5 | 4.0 - 9.0 | 3.0 - 9.0 | 0.0 - 3.0 | -- |
| MP-12 | 2/27/96 | PVC | 0.50 | 11.5 | 4.8 - 9.8 | 3.0 - 11.5 | 0.0 - 3.0 | -- |
| MP-13 | 2/27/96 | PVC | 0.50 | 10.5 | 5.0 - 10.0 | 3.0 - 10.5 | 0.0 - 3.0 | -- |
| MP-14 | 2/27/96 | PVC | 0.50 | 10.0 | 4.7 - 9.7 | 3.0 - 9.7 | 0.0 - 3.0 | -- |
| MP-15 | 2/27/96 | PVC | 0.50 | 13.0 | 8.0 - 13.0 | 5.0 - 13.0 | 0.0 - 5.0 | -- |
| MP-16 | 2/29/96 | SS | 0.50 | 19.5 | 19.0 - 19.5 | -- | 0.0 - 16.5 | -- |
| MP-17 | 2/28/96 | PVC | 0.50 | 11.0 | 4.5 - 9.5 | 3.0 - 11.0 | 0.0 - 3.0 | -- |
| MP-18 | 2/26/96 | PVC | 0.50 | 10.5 | 4.9 - 9.9 | 4.0 - 9.9 | 0.0 - 4.0 | -- |
| MP-19 | 2/28/96 | PVC | 0.50 | 13.0 | 7.8 - 12.8 | 4.0 - 12.8 | 0.0 - 4.0 | -- |
| MP-20 | 2/28/96 | PVC | 0.50 | 10.5 | 4.8 - 9.6 | 3.0 - 9.6 | 0.0 - 3.0 | -- |
| MP-21 | 2/27/96 | PVC | 0.50 | 10.5 | 4.5 - 9.5 | 3.0 - 10.5 | 0.0 - 3.0 | -- |
| MP-22 | 2/27/96 | PVC | 0.50 | 10.5 | 5.0 - 10.0 | 4.0 - 10.0 | 0.0 - 4.0 | -- |
| MP-23 | 3/1/96 | SS | 0.50 | 17.5 | 17.0 - 17.5 | -- | 0.0 - 16.0 | -- |
| MP-24 | 2/26/96 | PVC | 0.50 | 10.5 | 4.6 - 9.8 | 4.0 - 9.8 | 0.0 - 4.0 | -- |
| MP-25 | 2/28/96 | PVC | 0.50 | 9.5 | 4.0 - 9.0 | 3.0 - 9.0 | 0.0 - 3.0 | -- |
| MP-26 | 2/28/96 | PVC | 0.50 | 10.5 | 4.0 - 9.0 | 3.0 - 9.0 | 0.0 - 3.0 | -- |
| MP-27 | 2/28/96 | PVC | 0.50 | 10.5 | 5.0 - 10.0 | 4.0 - 10.0 | 0.0 - 4.0 | -- |
| MW-01 [b] | 2/21/95 | PVC | 2.0 | 16.5 | 4.5 - 14.5 | 3.5 - 16.5 | 1.5 - 3.5 | 0.5 - 1.5 |
| MW-02 [b] | 2/21/95 | PVC | 2.0 | 18.0 | 13.0 - 18.0 | 11.0 - 18.0 | 8.0 - 11.0 | 0.5 - 8.0 |

[a] For stainless steel sacrifical points, point is driven into native material (no sand pack).

[b] Monitoring wells were installed by Metcalf & Eddy (1995).

PVC: Polyvinyl chloride

SS: Stainless steel

**PARSONS ENGINEERING SCIENCE, INC.**

**BORING NUMBER: MP-01**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Mark Vessely | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 3/1/96 | **TOTAL DEPTH:** 9.75 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | **SC Fill?** | Dark Brown Clayey SAND with fine to medium gravel [Fill?] |
| 5 | ▼ | BE-MP01-5 [poor recovery] | NR/80 | | **ML** | Red Brown Clayey SILT with some fine sand and gravel, moist, no hydrocarbon odors |
| | | | NR/75 | | **SM** | Dark Brown Silty Medium SAND with gravel, moist, no hydrocarbon odors |
| 10 | | | | | | Total Depth 9.75' bgs<br>[no water in borehole at time of drilling] |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.
--- - Contact approximately located.
▽ - First encountered groundwater level.
▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.
TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-03**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/29/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | fill? | Dark Brown Clayey Sandy Fine GRAVEL, moist to wet, angular to rounded gravel, no hydrocarbon odors |
| | ▼ | | 0.8/0 | | ML/CL | Red-Brown Gravelly Clayey SILT/Silty CLAY with fine sand, moist, to wet, sub-rounded gravel, abundant organics, no hydrocarbon odor, soft |
| 5 | ▽ | BE-MP03-4.5 | 1.0/0 | | GC | Red-Brown Sandy Clayey Fine GRAVEL, moist to saturated, no hydrocarbon odors, angular gravel, fine to medium sand |
| | | | | | GC | Mottled Green and Brown Silty Clayey GRAVEL, moist, no hydrocarbon odors |
| 10 | | | 1.1/0 | | CL/ML | Mottled Green and Brown Gravelly Silty CLAY or Clayey SILT with Sand, moist, no hydrocarbon odors |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

beal1_27.CDR

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-08**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 1 inch |
| **COMPLETION DATE:** 2/27/96 | **TOTAL DEPTH:** 18 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0–10.5 | | | | | | 0 - 10.5' bgs same as MP-09 |
| 10.5–14 | | | | | ML/ CL | Same as above (see MP-09) |
| 14–16 | | | | | SM | Brown Gravelly Silty Fine to Coarse SAND, moist to wet, no hydrocarbon odors |
| 16–17.5 | | | 0.0/0 | | ML/ CL | Mottled Olive-Green and Brown Clayey SILT/Silty CLAY with sand, moist, stiff |
| 17.5–18 | | | | | SM | Brown Gravelly Silty Fine to Coarse SAND, moist to wet, no hydrocarbon odors |
| 18 | | | | | | Total Depth 18' bgs |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

beal1_27.CDR

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-09**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/27/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | FILL: Sand, Silt, Gravel and Clay, moist |
| | ▼ ▽ | | 5.9/40 | | fill | Compost: Primarily wood chips, moist to wet, no hydrocarbon odors |
| 5 | | BE-MP09-6 | 0.0/15 | | ML | Brown Clayey SILT with sand and gravel, moist to wet, no hydrocarbon odors |
| | | | | | SM | Brown Gravelly Silty Fine to Coarse SAND with clay, saturated, no hydrocarbon odors |
| 10 | | BE-MP09-10 | 0.0/0 | | ML/CL | Mottled Olive-Green and Brown Clayey SILT/Silty CLAY, moist, stiff, black organics |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

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# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-10**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/28/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Brown Clayey SILT with fine gravel and trace sand, moist to wet, soft, Color change to Black or Dark Grey at 1.5' bgs, hydrocarbon odor [heavy HC?] |
| | ▼ | | 0.8/40 | | ML | Brown Gravelly Sandy SILT, moist to wet, stiff, some lenses of gravelly silty fine to medium sand, moderate gasoline odor at 5' bgs with color change to green. |
| 5 | ▽ | | 20/60 | | SM/SW | Brown Silty Gravelly Fine to Coarse SAND, saturated, slight hydrocarbon odor, rounded fine gravel |
| | | | | | ML | Mottled Olive-Green and Brown Clayey SILT with sand and gravel, moist, no hydrocarbons odor, stiff |
| 10 | | | 1.4/3 | | CL | Olive-Green Silty CLAY, very stiff, no hydrocarbon odor |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

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PARSONS ENGINEERING SCIENCE, INC.



**BORING NUMBER: MP-11**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/28/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Red-Brown Clayey SILT, moist to wet, soft, no hydrocarbon odors |
| | ▼ | | 0.0/0 | | CL | Red-Brown Silty CLAY, moist, stiff, no hydrocarbon odors<br>Color change at ~4' bgs to mottled olive-green and brown with abundant organics |
| 5 | ▽ | | 90/60 | | SM | Brown Silty Gravelly Fine to Coarse SAND, moist to wet, minor clay<br>Slight gasoline odor at 7 to 7.5' bgs |
| | | | | | SW | Brown Gravelly Medium to Coarse SAND with silt and clay, saturated, slight gasoline odor [?], sub-rounded gravel |
| 10 | | | 0.0/0 | | CL | Mottled Grey and Brown Silty CLAY, moist, hard, no hydrocarbon odors |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.
--- - Contact approximately located.
▽ - First encountered groundwater level.
▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.
TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-12**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/27/96 | **TOTAL DEPTH:** 11.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Brown Clayey SILT with sand and gravel, wet near surface, soft, below 1' bgs becomes dry to damp, stiff and friable, no hydrocarbon odors, abundant organics |
| | | BE-MP12-4 | 0.0/0 | | ML | Mottled Olive-Brown and Brown Clayey SILT, moist to damp, stiff, abundant organics, no hydrocarbon odor |
| 5 | ▽▼ | | | | SM | Mottled Olive-Green and Brown Silty Very Fine to Fine SAND, wet to saturated, minor gravel, no hydrocarbon odor<br>Becomes Brown at ~5.5' bgs |
| | | | 0.0/0 | | ML | Mottled Olive-Green and Brown Clayey SILT, moist, very stiff |
| | | | | | ML | Mottled Olive-Green and Brown, Clayey Gravelly Sandy SILT, moist to wet, no hydrocarbon odors |
| 10 | | | 0.0/0 | | CL | Mottled Olive-Green Silty CLAY with fine sand and fine gravel, moist, stiff, no hydrocarbon odor |
| | | | | | | Total Depth 11.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

## PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-13**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/27/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0–5 | ▼ (~4) ▽ (~5) | | 0.0/0 | | ML | Red-Brown Clayey SILT, moist, occasional fine gravel, no hydrocarbon odors, some rootlets, soft<br>Becomes friable and dry at ~2' bgs<br>At 3' bgs soils are gravelly and sandy |
| 5–8 | | BE-MP13-6.5 | 230/50 | | SM | Mottled Grey-Brown and Brown Silty Gravelly Fine to Coarse SAND, moist to wet, angular gravel, slight to moderate gasoline odor |
| 8–10.5 | | | 210/65 | | ML/ CL | Mottled Olive-Green and Brown Clayey SILT/Silty CLAY, moist, slight to no hydrocarbon odors, very stiff to hard |
| 10.5 | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.
--- - Contact approximately located.
▽ - First encountered groundwater level.
▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.
TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-14**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/27/96 | **TOTAL DEPTH:** 10 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Black Gravelly SILT with sand, wet, fine angular gravel |
| | ▼ | | 0.0/0 | | ML | Red-Brown Clayey Gravelly SILT with sand, moist, soft, no hydrocarbon odors |
| 5 | | BE-MP14-7 | 475/390 | | SM | Red-Brown Gravelly Silty Fine to Medium SAND, moist, trace clay, no hydrocarbon odor<br>Moderate gasoline odor at 6.5' |
| | | | 118/26 | | ML/CL | Mottled Olive-Green and Brown Clayey SILT/Silty CLAY with fine sand, moist to wet, slight gasoline odor, stiff |
| 10 | | | | | | Total Depth 10' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-15**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/27/96 | **TOTAL DEPTH:** 13 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | 0.0/0 | | ML | Red-Brown Clayey SILT, wet, soft, rootlets, trace sand and fine gravel |
| 5 | ▼ | | 0.0/0 | | ML | Red-Brown Gravelly SILT with Clay and Sand, moist, no hydrocarbon odor, fine angular gravel, fine sand<br>Color change to Olive-Green at ~ 5.5' bgs |
| | | BE-MP15-9.5 | | | SM | Olive-Green Gravelly Silty Fine to Medium SAND, wet, minor clay [?], no hydrocarbon odors, fine sub-angular to angular gravel, very silty<br>Moderate gasoline odor at ~ 9' bgs |
| 10 | | | 0.0/0 | | ML | Mottled Olive-Green and Brown Clayey SILT, moist to wet, hard, slight hydrocarbon odor [?]<br>Color change to Olive Green at ~12' bgs |
| | | | 0.0/0 | | | |
| 15 | | | | | | Total Depth 13' bgs<br>[No water in borehole at time of drilling] |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-16**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Mark Vessely | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/29/96 | **TOTAL DEPTH:** 19.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| 5 | | | | | | 0 - 13' bgs same as MP-15 |
| 10 | | | | | | Driller reports softness at 11' bgs |
| 15 | | | 0.0/0 | | ML | Olive-Green Clayey SILT, moist, no hydrocarbon odors |
| | ∇ | | 0.2/10<br>1.0/10 | | SM | Red-Brown silty SAND with clay [borehole filling with water after sampling past 17.5] |
| | | | 1.0/10 | | ML | Red-Brown Gravelly SILT with coarse sand, wet, no hydrocarbon odor |
| 20 | | | | | | Total Depth 19.5' bgs |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

∇ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-17**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/28/96 | **TOTAL DEPTH:** 11 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Red-Brown Clayey SILT, moist to wet, rootlets, occasional fine Gravel and Sand, no hydrocarbon odors, soft |
| | | | | | CL | As above except Silty CLAY |
| | | | 0.0/0 | | GM/ML | Red Brown Sandy Silty GRAVEL/Gravelly SILT, moist to wet, no hydrocarbon odors |
| 5 | | | | | | |
| | ▼ ▽ | | 17/40 | | ML | Red Brown Clayey SILT with Sand and Gravel, moist to wet, no hydrocarbon odors |
| | | | | | GM | Brown Silty Sandy GRAVEL, saturated, fine angular gravel, fine to coarse sand, no hydrocarbon odors |
| 10 | | | 0.8/0 | | ML | Tan Clayey SILT, moist, no hydrocarbon odors |
| | | | | | | Total Depth 11' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-18**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/26/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | ▽ | BE-MP18-3.0 | 0.0/0 | | ML | Brown Clayey Gravelly sandy SILT, wet, soft, very fine to fine sand |
| 5 | ▼ | | | | ML | Light Brown Sandy SILT, moist, very fine sand |
| | | | 0.0/0 | | SM | Mottled Light Brown Silty Fine SAND, moist to wet |
| 10 | | | 0.0/0 | | GP | Mottled Brown and Grey-Green Sandy Fine GRAVEL with silt and clay, saturated, angular gravel, fine to coarse sand |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-19**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/28/96 | **TOTAL DEPTH:** 13 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | 0.0/0 | | ML/CL | Red-Brown Clayey SILT/Silty CLAY with fine Gravel, moist to saturated (saturated near surface), no hydrocarbon odor, soft |
| 5 | ▼ | BE-MP19-7 | 0.0/0 | | GC | Red Brown Clayey Sandy Fine GRAVEL with Silt, moist to wet, no hydrocarbon odors, sand is fine to coarse, angular gravel |
| | | | 0.0/0 | | SC | Red Brown Clayey Gravelly Fine to Coarse SAND, moist to wet, no hydrocarbon odors |
| 10 | | | | | CL | Mottled Olive-Green and Brown Sandy Gravelly CLAY with SILT, moist to wet, no hydrocarbon odors, hard |
| | | | | | GC | Red-Brown and Grey Clayey Sandy Fine GRAVEL, damp to moist, no hydrocarbon odors |
| | | | | | | Total Depth 13' bgs<br>[No water in hole at 13' bgs] |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-20**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/28/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | 0.0/0 | | ML/CL | Red-Brown Clayey SILT/Silty CLAY with fine Gravel, wet to saturated near surface, organics, soft<br>Change at 1.5' bgs to damp and friable - very stiff, no hydrocarbon odor, more silt than clay |
| 5 | | | 0.6/0 | | GC/SC | Red Brown Clayey Sandy Fine GRAVEL/Clayey Gravelly Fine to Coarse SAND, saturated, no hydrocarbon odor<br>Mottled Brown and Olive-Green, as above at 8' bgs |
| 10 | | | 1.2/10 | | CL | Mottled Brown and Olive Green Silty CLAY, moist to wet, very stiff, no hydrocarbon odors |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

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# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-21**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/27/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Red-Brown Clayey SILT, moist to wet, abundant organics, minor gravel, soft |
| | ⊻ ▼ | | 0.0/0 | | | |
| | | | | | ML | Red-Brown Gravelly Sandy SILT, wet to saturated |
| 5 | | | 0.0/0 | | SW | Brown Gravelly Fine to Coarse SAND with silt, saturated, no hydrocarbon odors |
| | | | | | GP | Brown Sandy Fine GRAVEL with silt, saturated, no hydrocarbon odor, fine to coarse sand |
| 10 | | | 0.0/0 | | ML | Olive-Green Clayey Gravelly SILT with sand, moist, no hydrocarbon odors, stiff |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

⊻ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

## PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-22**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/27/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | ▼ | | 0.0/0 | | ML | Red-Brown Clayey SILT with sand, moist to wet, soft, no hydrocarbon odors, rootlets |
| 5 | | | | | | Red-Brown Gravelly Silty Fine to Medium SAND/Sandy SILT with clay, moist to wet, fine gravel, some organics |
| | ▽ | BE-MP22-7 | 20/10 | | SM/ ML | At 6.5' bgs, gasoline odors and greenish color, saturated at 7.5 - 8' bgs |
| | | | | | | 3" layer of Silty CLAY at ~ 9.5-9.8' bgs |
| 10 | | | 0.0/0 | | | No apparent hydrocarbon odors below 9' bgs |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

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## PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-23**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Michael Phelps | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 3/1/96 | **TOTAL DEPTH:** 17.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | | | 0.7/10 | | | |
| 5 | | | 1.1/70 | | | |
| | | BE-MP23-6.5 | | | | |
| | | BE-MP43-7.0 | | | | |
| | | | 1.7/70 | | | |
| | | | | | | 0-16.5' same as MP-17 |
| 10 | | | | | | |
| 15 | | | | | | |
| | | | | | ML | Olive-Green Clayey Gravelly SILT, moist, no hydrocarbon odors |
| | | | 1.8/0 | | ML | Red-Brown Sandy SILT with gravel, moist, no hydrocarbon odors |
| | | | | | | Total Depth 17.5' bgs |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

**PARSONS ENGINEERING SCIENCE, INC.**

**BORING NUMBER: MP-24**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/26/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Brown SILT [TOPSOIL], wet, soft, abundant grasses |
| | | | | | GM | Brown Silty Fine to Medium GRAVEL with fine sand, angular, gravel, moist |
| | ▼ | BE-MP24-3 | 0.4/0 | | ML | Brown Clayey Sandy SILT, wet to saturated, very soft |
| 5 | | | | | SM | Brown Silty Gravelly Fine to Medium SAND, wet |
| | | | 0.1/0 | | GM | Brown Silty Fine GRAVEL with sand, moist to wet, angular gravel |
| | | | | | SP | Mottled Brown Gravelly Fine SAND with silt, wet, fine angular gravel |
| 10 | | | 0.0/0 | | ML/CL | Mottled Grey and Brown Clayey SILT/ Silty CLAY, moist, stiff |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

∇ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-25**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/28/96 | **TOTAL DEPTH:** 9.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Brown to Red-Brown Clayey SILT, moist to wet, no hydrocarbon odors, soft, rootlets, trace of fine sub-rounded gravel |
| | ▼ (equilibrated) | | 0.2/0 | | | |
| 5 | ▽ (first encountered) | | | | SM | Brown Gravelly Silty Fine to Coarse SAND, moist to saturated, angular gravel, no hydrocarbon odors, some lenses of Gravelly SAND (SW) |
| | | BE-MP25-7 | 0.1/0 | | | |
| | | | 0.8/0 | | CL/ML | Mottled Olive-Green and Brown Silty CLAY/Clayey SILT, moist to wet, stiff, no hydrocarbon odors |
| 10 | | | | | | Total Depth 9.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

## PARSONS ENGINEERING SCIENCE, INC.



**BORING NUMBER: MP-26**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/28/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | Soil Headspace PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | ML | Red-Brown Clayey SILT, moist to wet, rootless, no hydrocarbons, soft |
| | ▼ | | 2.5/5 | | | |
| 5 | ▽ | | 2.7/2 | | GM/ GC | Red Brown Clayey Sandy Fine GRAVEL, moist to saturated, no hydrocarbon odors, angular gravel, silty between 2 and 4 feet.<br>Faint odor of gasoline (?) at 6' to 7'. |
| 10 | | | 0.7/0 | | ML | Mottled Olive-Green and Brown Clayey SILT, moist to wet, very stiff, no hydrocarbon odors, occasional gravel |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

## PARSONS ENGINEERING SCIENCE, INC.

**BORING NUMBER: MP-27**

| | |
|---|---|
| **PROJECT NUMBER:** 722450.14020 | **PROJECT NAME:** Beale Intrinsic Remediation Treatability Study |
| **CLIENT:** AFCEE | |
| **LOCATION:** Beale Air Force Base, California<br>UST Sites 10-494, 10-495 and 10-496 | **DRILLING METHOD:** Geoprobe |
| **GEOLOGIST:** Marcus Pierce | **HOLE DIAMETER:** 2 inches |
| **COMPLETION DATE:** 2/28/96 | **TOTAL DEPTH:** 10.5 feet below ground surface |

| DEPTH (feet) | GW ELEVATION | SAMPLE NUMBER | SOIL HEADSPACE PID/TVH (ppmv) | GEOLOGIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | 0.3/0 | | ML | Red-Brown Clayey SILT with fine gravel and sand, angular to sub-angular gravel; moist to wet, rootlets, no hydrocarbon odors, stiff below 1' bgs |
| | ▼ | | | | | Gravelly between 2.6 and 3.6' bgs |
| 5 | ▽ | | 0.5/6 | | | Some thin lenses of Silty Sandy Fine Gravel<br>Saturated at ~5 - 6' bgs, no hydrocarbon odors |
| 10 | | | 0.3/5 | | CL/ ML | Mottled Olive-Green, Brown and Black Silty CLAY/Clayey SILT, moist to wet, no hydrocarbon odors, trace fine gravel, stiff |
| | | | | | | Total Depth 10.5' bgs |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

— - Contact.

--- - Contact approximately located.

▽ - First encountered groundwater level.

▼ - Equilibrated groundwater level.

PID - Photoionization detector reading.

TVH - Total Volatile Hydrocarbon meter reading.

NA - Not Applicable.

# APPENDIX B

# SOIL AND GROUNDWATER ANALYTICAL RESULTS FROM PREVIOUS INVESTIGATIONS

# UST SITE SUMMARY
# TANK NOS. 10-494, 10-495 AND 10-496

Tanks 10-494, 10-495, and 10-496 were historically located near the intersection of 30th and A Streets at Beale AFB. In accordance with the 1944 Completion Unit Layout Maps for Camp Beale, all three tanks were 12,000 gallon gasoline tanks. According to Beale AFB personnel, all three tanks were removed prior to 1962. The excavation pit is currently utilized as a compost pile for landscape waste.

This site was originally investigated by Law Environmental (LAW) in December 1994. LAW advanced seven (7) vapor points around the tank site and sampled the soil gas vapors. Analytical results of these samples established the presence of total petroleum hydrocarbons at concentrations as high as 27,000 parts per million by volume (ppmv) and benzene as high as 88 ppmv. Water was encountered in the tank pit area at six feet below ground surface. A visual inspection of the groundwater indicated the presence of free product. Soil gas sampling locations are shown on Figure 1. Analytical results are summarized in Table 1.

**Table 1. Analytical Summary - Soil Gas Samples**

| Sample ID | Sample Depth (ft.bgs) | TPH Concentration (ppmv) | Benzene (ppmv) |
|---|---|---|---|
| SVP-132 | 6.5 | 27,120 | 6 |
| SVP-133 | 7.5 | 226 | 1 |
| SVP-134 | 8.5 | ND | ND |
| SVP-142 | 8 | 23,620 | 88 |
| SVP-143 | 7.5 | 12,030 | 15 |
| SVP-144 | 7.5 | 1065 | 12 |
| SVP-145 | 5.5 | 1 | 0.02 |

ppmv: Parts per million by volume
ft.bgs: Feet below ground surface

As part of Metcalf and Eddy's investigation program, a total of seven (7) soil borings were advanced in the site vicinity to depths ranging from 6 feet to 18 feet below ground surface (bgs). Two of the borings were converted to monitoring wells (MW-1, MW-2). In addition, a total of seven (7) test pits (TP-8 through TP-14) were excavated to assist in the characterization process. The test pits were excavated to depths ranging from 6 feet to 9 feet bgs. Soil boring and test pit locations are shown on Figure 1.

During the field investigation at this site, groundwater was encountered in soil borings and test pits at depths ranging from 3 feet to 6 feet bgs. Photoionization detector (PID) readings observed ranged from <1 part per million (ppm) up to 2,500 ppm. The highest PID readings were observed in SB3, SB4, SB7, TP9, TP12, TP-13 and TP-14. Selected soil and groundwater samples were also collected and submitted to a state certified laboratory for analysis. The laboratory report is attached and summarized in Table 2.

## Table 2. Analytical Summary - Metcalf & Eddy
## Site 10-494/10-495/10-496

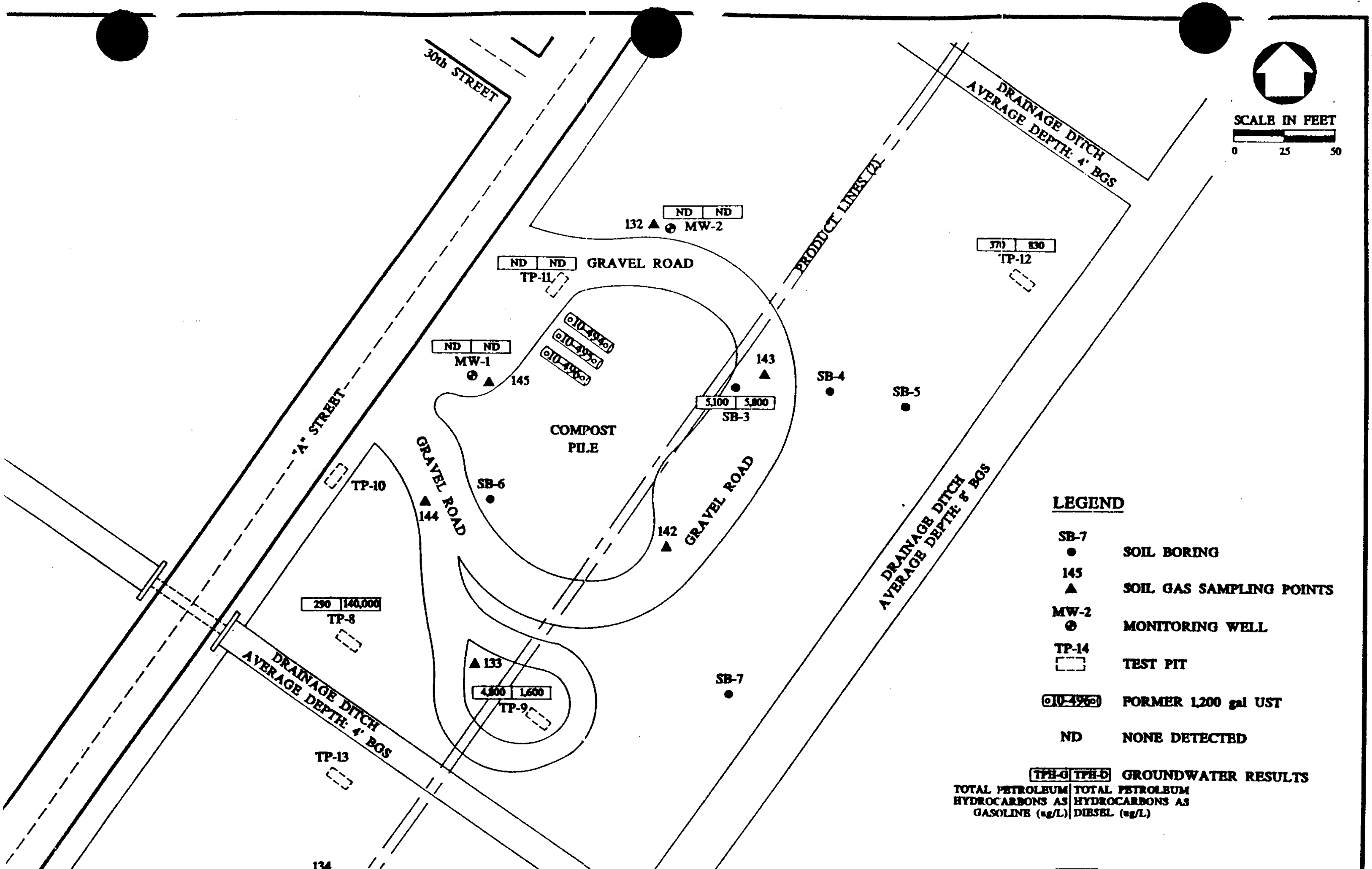
| SOIL | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample ID | SampleDate (ft.bgs) | Sample Depth | TPH-G (ug/g) | TPH-D (ug/g) | Benzene (ug/g) | Ethylbenzene (ug/g) | Xylenes (ug/g) | Total Lead (mg/kg) |
| SB1 | 02/21/95 | 6 | <1 | <1 | <0.005 | <0.005 | <0.005 | 1.2 |
| SB1 | 02/21/95 | 16 | <1 | <1 | <0.005 | <0.005 | <0.005 | 2.9 |
| SB2 | 02/22/95 | 18 | <1 | <1 | <0.005 | <0.005 | <0.005 | 0.94 |
| SB2 | 02/22/95 | 6.5 | <1 | <1 | <0.005 | <0.005 | <0.005 | 1.9 |
| SB3 | 02/22/95 | 6 | 27 | 18 | <0.02 | <0.02 | <0.02 | 5.2 |
| SB4 | 02/22/95 | 5.5 | 180 | 19 | <0.40 | <0.40 | 0.83 | 1.9 |
| SB5 | 02/23/95 | 9 | <1 | <1 | <0.005 | <0.005 | <0.005 | NA |
| SB5 | 02/23/95 | 6.5 | <1 | <1 | <0.005 | <0.005 | <0.005 | 1.6 |
| SB5 | 02/23/95 | 11 | <1 | <1 | <0.005 | <0.005 | <0.005 | 1.5 |
| SB6 | 02/23/95 | 5.5 | <1 | 25 | <0.005 | <0.005 | <0.005 | 4.8 |
| SB7 | 02/23/95 | 5.5 | <1 | <1 | <0.005 | <0.005 | <0.005 | 1.8 |
| SB7 | 02/23/95 | 11.5 | <1 | <1 | <0.005 | <0.005 | <0.005 | 1.4 |
| Test Pit 10 | 03/29/95 | 6 | <1 | <1 | <0.005 | <0.005 | <0.005 | 1.6 |
| Test Pit 11 | Stained soil observed at six feet bgs. PID readings were >1000 ppm. | | | | | | | |
| Test Pit 12 | Stained soil observed at six feet bgs. PID readings were >1000 ppm. | | | | | | | |

| WATER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Sample Date | Sample Depth (ft.bgs) | TPH-G (ug/L) | TPH-D (ug/L) | Benzene (ug/L) | Toluene (ug/L) | Ethyl-benzene (ug/L) | Xylenes (ug/L) | Total Lead (ug/L) |
| MW-1 | 03/15/95 | 3.7 | <50 | <50 | <0.3 | <0.3 | <0.5 | <0.5 | <5.0 |
| SB3 | 02/22/95 | 5 | 5100 | 5800 | 4 | 10 | 8.6 | 50 | NA |
| Test Pit 8 | 03/29/95 | 6 | 290 | 140000 | <0.6 | <0.6 | <1.0 | <1.0 | <5.0 |
| Test Pit 9 | 03/29/95 | 6 | 4800 | 1600 | 3.8 | 2.4 | 4.9 | 11 | <5.0 |
| Test Pit 11 | 03/29/95 | 5.5 | <50 | <50 | <0.3 | <0.3 | <0.5 | <0.5 | <5.0 |
| Test Pit 12 | 03/29/95 | 8 | 370 | 830 | <0.6 | <1.0 | <1.0 | <1.0 | 7.4 |
| MW2 | 05/02/95 | 6 | <50 | <50 | <0.3 | <0.3 | <0.3 | <0.3 | <0.02 |

ug/g: Micrograms per gram (parts per million)
ug/L: Micrograms per liter (parts per billion)
mg/kgs: Milligrams per kilogram (parts per million)
NA: Not analyzed
<: Less than (method detection limit)
>: Greater than
ft.bgs: Feet below ground surface

Based on the distribution of contaminants observed at this site, the westerly extent of contamination appears to be defined by TP-10, MW-1, and MW-2 (Figure 1). All other contaminant boundaries are presently undefined. Given the visual observations and PID readings observed in Test Pits 13 and 14, the southern extent of contamination appears to be extensive. The PID readings also indicate that the contamination has migrated either through or beneath the drainage ditch located south of the site. This ditch, as well as the other two ditches to the north and east, may affect the shallow groundwater flow direction in the immediate vicinity and provide a mechanism for contaminant migration.

The source of contamination at this site may be associated with the former tanks or the product line located east of the tanks which historically supplied fuel to several service stations along A street. Additional investigations at this site will be necessary to determine the source, define the full extent of contamination, and establish a groundwater flow direction and gradient.




BEALE AIR FORCE BASE
UST REMOVAL PROGRAM

SITE DIAGRAM FOR USTs #10-494, #10-495 & #10-496

FIGURE 1

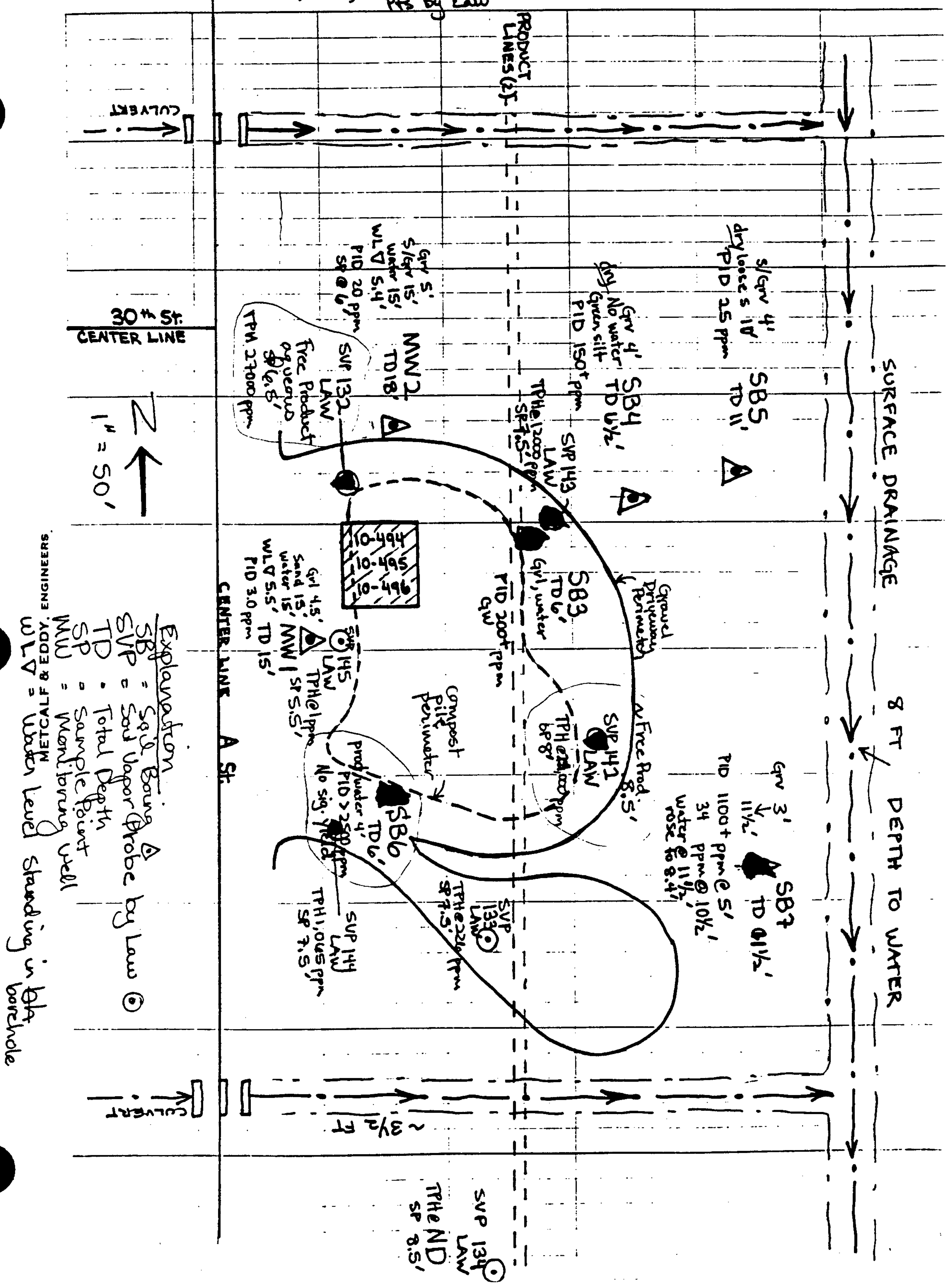
DATE: MAY 1995

M&E Metcalf & Eddy Inc.

Project ________ Acct. No. ________ Page ___ of ___

Subject UST site 10-494/10-495/10-496 Comptd. By Katy Ely Date 2/24/98

Detail Location of MW, SB, & Soil Vapor Pts by Law Ck'd. By ________ Date ________



LAW COMPANIES
Project # 221640003
BEALE AFB - Marysville, CA

Aqueous sample appears to have free product.

TEG PROJECT #940822C

EPA METHODS 8010, 8020 (BTEX) & mod8015 (TPH) ANALYSES OF SOIL VAPORS in ppmV

| SAMPLE NUMBER: | | A001L 127VP 001SV | A001L 128VP 001SV | A001L 129VP 001SV | A001L 130VP 001SV | A001L 132VP 001SV | A001L 133VP 001SV | A001L 134VP 001SV | A001L 135VP 001SV |
|---|---|---|---|---|---|---|---|---|---|
| COLLECTION DATE: | | 9/26/94 | 9/26/94 | 9/26/94 | 9/26/94 | 9/26/94 | 9/26/94 | 9/26/94 | 9/26/94 |
| COLLECTION TIME: | | 10:26 | 10:29 | 10:42 | 11:35 | 11:56 | 12:40 | 13:13 | 14:43 |
| COLLECTION DEPTH (feet): | | 13.5 | 7.5 | 7.5 | 13.5 | 6.5 | 8.0 | 8.5 | 7.5 |
| VINYL CHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| METHYLENE CHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| trans-1,2 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1 DICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| cis-1,2 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| CHLOROFORM | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1,1 TRICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| CARBON TETRACHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,2 DICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| TRICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,2 DICHLOROPROPANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| BROMODICHLOROMETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| cis-1,3 DICHLOROPROPENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| trans-1,3 DICHLOROPROPENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1,2 TRICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| TETRACHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| BENZENE | (ppmV) | nd | nd | nd | nd | 6.15 | 0.68 | nd | nd |
| TOLUENE | (ppmV) | nd | nd | nd | nd | 9.63 | 0.58 | nd | nd |
| ETHYLBENZENE | (ppmV) | nd | nd | nd | nd | 0.32 | 0.07 | nd | |
| TOTAL XYLENES | (ppmV) | nd | nd | nd | nd | 1.32 | 0.18 | nd | |
| TPH | (ppmV) | nd | nd | nd | nd | 27120 | 226 | nd | |

REPORTING LIMITS FOR ABOVE COMPOUNDS = 0.01 Part per Million by Volume (ppmV) (TPH & Vinyl Chloride =
'nd' NOT DETECTED AT LISTED REPORTING LIMITS

ANALYSES PERFORMED IN TEG's DHS CERTIFIED MOBILE LAB (#1671)
ANALYSES PERFORMED BY: Mr. Leif Jonsson & Ms. Stacie Wissler
DATA REVIEWED BY: Mr. Mark Jerpbak



Transglobal Environmental Geochemistry
PO Box 162580, Sacramento, CA 95816 Phone: (916) 736-3233 Fax: (916) 452-5806

**LAW COMPANIES**
**Project # 221640003**
**BEALE AFB - Marysville, CA**

TEG PROJECT #940822C

EPA METHODS 8010, 8020 (BTEX) & mod8015 (TPH) ANALYSES OF SOIL VAPORS in ppmV

| SAMPLE NUMBER: | | A001L 136VP 001SV | A001L 137VP 001SV | A001L 138VP 001SV | A001L 139VP 001SV | A001L 140VP 001SV | A001L 141VP 001SV | A001L 141VP 001SV dup | A001L 142VP 001SV |
|---|---|---|---|---|---|---|---|---|---|
| COLLECTION DATE: | | 9/26/94 | 9/26/94 | 9/27/94 | 9/27/94 | 9/27/94 | 9/27/94 | 9/27/94 | 9/27/94 |
| COLLECTION TIME: | | 14:48 | 15:06 | 8:30 | 8:25 | 9:20 | 9:01 | 9:01 | 10:36 |
| COLLECTION DEPTH (feet): | | 13.5 | 13.5 | 8.5 | 13.0 | 6.5 | 7.5 | 7.5 | 8 0 |
| VINYL CHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| METHYLENE CHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| trans-1,2 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1 DICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| cis-1,2 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| CHLOROFORM | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1,1 TRICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| CARBON TETRACHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,2 DICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| TRICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,2 DICHLOROPROPANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| BROMODICHLOROMETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| cis-1,3 DICHLOROPROPENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| trans-1,3 DICHLOROPROPENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1,2 TRICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| TETRACHLOROETHENE | (ppmV) | nd | nd | nd | nd | 0.02 | 0.24 | 0.25 | nd |
| BENZENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | 87.66 |
| TOLUENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | 36.98 |
| ETHYLBENZENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | 2.12 |
| TOTAL XYLENES | (ppmV) | nd | nd | nd | nd | nd | nd | nd | 5.69 |
| TPH | (ppmV) | nd | nd | nd | nd | 3 | nd | nd | 23620 |

REPORTING LIMITS FOR ABOVE COMPOUNDS = 0.01 Part per Million by Volume (ppmV) (TPH & Vinyl Chloride = 1 ppmV)

'nd' NOT DETECTED AT LISTED REPORTING LIMITS

ANALYSES PERFORMED IN TEG's DHS CERTIFIED MOBILE LAB (#1671)

ANALYSES PERFORMED BY: Mr. Leif Jonsson & Ms. Stacie Wissler

DATA REVIEWED BY: Mr. Mark Jerpbek



Transglobal Environmental Geochemistry

PO Box 162580, Sacramento, CA 95816 Phone: (916) 736-3233 Fax: (916) 452-5806

LAW COMPANIES
Project # 221640003
BEALE AFB - Marysville, CA

TEG PROJECT #940822C

EPA METHODS 8010, 8020 (BTEX) & mod8015 (TPH) ANALYSES OF SOIL VAPORS in ppmV

| SAMPLE NUMBER: | | A001L 143VP 001SV | A001L 144VP 001SV | A001L 145VP 001SV | A001L 145VP 002SV | A001L 146VP 001SV | A001L 147VP 001SV | A001L 147VP 001SV dup | A001L 147VP 003SV |
|---|---|---|---|---|---|---|---|---|---|
| COLLECTION DATE: | | 9/27/94 | 9/27/94 | 9/27/94 | 9/27/94 | 9/27/94 | 9/27/94 | 9/27/94 | 9/27/94 |
| COLLECTION TIME: | | 10:36 | 10:53 | 11:02 | 11:25 | 14:13 | 14:45 | 14:45 | 15:07 |
| COLLECTION DEPTH (feet): | | 7.5 | 7.5 | 7.0 | 5.5 | 8.5 | 10.5 | 10.5 | 5.0 |
| VINYL CHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| METHYLENE CHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| trans-1,2 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1 DICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| cis-1,2 DICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| CHLOROFORM | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1,1 TRICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| CARBON TETRACHLORIDE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,2 DICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| TRICHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | 0.08 | 0.07 | nd |
| 1,2 DICHLOROPROPANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| BROMODICHLOROMETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| cis-1,3 DICHLOROPROPENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| trans-1,3 DICHLOROPROPENE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| 1,1,2 TRICHLOROETHANE | (ppmV) | nd | nd | nd | nd | nd | nd | nd | nd |
| TETRACHLOROETHENE | (ppmV) | nd | nd | nd | nd | nd | 0.11 | 0.12 | nd |
| BENZENE | (ppmV) | 15.35 | 11.72 | 0.02 | nd | nd | nd | nd | nd |
| TOLUENE | (ppmV) | 3.84 | 4.17 | 0.04 | nd | 0.11 | nd | nd | nd |
| ETHYLBENZENE | (ppmV) | 0.09 | 0.35 | 0.06 | nd | 0.02 | nd | nd | nd |
| TOTAL XYLENES | (ppmV) | 0.57 | 1.92 | 0.13 | nd | 0.11 | nd | nd | nd |
| TPH | (ppmV) | 12030 | 1065 | 7 | 1 | 10 | nd | nd | nd |

REPORTING LIMITS FOR ABOVE COMPOUNDS = 0.01 Part per Million by Volume (ppmV) (TPH & Vinyl Chloride = 1 ppmV)
'nd' NOT DETECTED AT LISTED REPORTING LIMITS

ANALYSES PERFORMED IN TEG's DHS CERTIFIED MOBILE LAB (#1671)
ANALYSES PERFORMED BY: Mr. Leif Jonsson & Ms. Stacie Wissler
DATA REVIEWED BY: Mr. Mark Jerpbak



Transglobal Environmental Geochemistry
PO Box 162580, Sacramento, CA 95816 Phone: (916) 736-3233 Fax: (916) 452-5806

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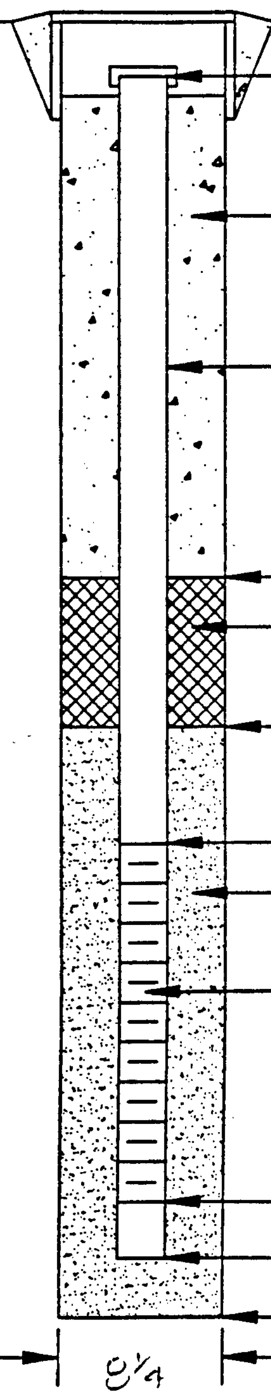
# MONITORING WELL CONSTRUCTION DIAGRAM

| PROJECT: Beale AFB UST Removal Investigations | JOB NO.: | WELL NO.: MW-1 |
|---|---|---|
| CLIENT: AFCEE | WELL SITE: 494/495/496<br>10-~~594/595/596~~ | |
| SUPERVISOR: Tom Venus<br>DRILLER: Kevin [illegible] | BEGUN: 1100, 7/21/95<br>FINISHED: 1505, 7/21/95 | WATER LEVEL (Depth/Elev.):<br>5.5' at boring completion |



GROUND LEVEL

MONUMENT TYPE:

LOCK/KEY TYPE:

1.0' cutoff
5.0 blank
10.0 screen
0.5 endcap
14.5

1 bag

3½ bags

METHOD DRILLED:
HSA

METHOD DEVELOPED:

| | DEPTH (In Feet) | ELEV. (In Feet) |
|---|---|---|
| TOP OF RISER CASING | 0.5 | |
| SANITARY SEAL TYPE: Portland cement concrete | | |
| RISER CASING TYPE: Sch 40 PVC | | |
| RISER CASING DIA: 2" | | |
| TOP OF SEAL | 1.5 | |
| TRANSITION SEAL TYPE: Hydrated bentonite [illegible] | | |
| BOTTOM OF SEAL | [illegible] | |
| TOP OF SCREEN | [illegible] | |
| FILTER MATERIAL TYPE: Lonestar #2/16 sorted sand | | |
| SCREEN DIA: 2" TYPE: Sch 40 PVC | | |
| SLOT SIZE: 0.010" TYPE: cut | | |
| BOTTOM OF SCREEN | 14.5 | |
| BOTTOM OF SUMP | 15.0 | |
| TOTAL DEPTH DRILLED | 16.5 | |

8¼
HOLE DIAMETER

COMMENTS:

C:\ACADDWGS\MWFLUSH

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# GEOLOGIC LOG

| | | | |
|---|---|---|---|
| PROJECT: Beale AFB UST Remedial Investigations | | SHEET 1 of | BORING NO. SB-1 |
| SITE LOCATION: 123' south of 30th St ℄, east of A St. ℄ | JOB NO.: 12619 | | |
| | LOCATION: 494/495/496 10 | GROUND ELEV. ~130 | TOTAL DEPTH 15.0 drilled 16.5 sampled |
| DRILL CONTRACTOR: Turner Exploration | GEOLOGIST: Tom Vezina | | BEGUN: 1315 7/21/95 |
| DRILL RIG: Mobile B-61 | DRILLER: Kevin Barnett | | FINISHED: 1400 7/21/95 |
| HOLE SIZE: 8½ | WEATHER: warm | | GROUND WATER (DEPTH/ELEV.): |
| DRILLING METHOD: Hollow stem auger | DRILLING FLUID/SOURCE: NONE | | TOP OF ROCK (DEPTH/ELEV.): NOT ENCOUNTERED |

| DEPTH | SAMPLE TYPE/NO. | SAMPLE DEPTH | SAMPLE RECOVERY | BLOW COUNT (per 6 inches) | ~~PERCENT RECOVERY~~ | NOTES: PRODUCT ODOR, OVA MEASURMENT, ETC. | TIME LOG | USCS LOG | STRATIGRAPHIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | PID ↓ | organic, compost used in area masks any/minor product odor, if present | 1315 | CL | Red, ~~[illegible]~~, dry clay |
| 5 | | | SS | 6 | 0.0 | COBBLE @ 4.5 ∇ | 1325 | ML | SL moist, gray w/ med brn/orange mottling, fine sandy silt, low plasticity |
| | SB1-6.0 | | 1.5 | 11 | | | | | |
| | | | | | | Driller feels gravels 8-10 | | CH? | |
| 10 | | | | | | | 1335 | CL | Moist, lt. brn/gray ~~[illegible]~~ clay w/ black and orange mottling, minor gravels at lower end [illegible] |
| | SB1- | 10.5 | SS | 9 | 0.0 | | | | |
| | | | 1.5 | 12 | | | | | |
| 15 | | | SS | | 2.0 | PID 3.0 [illegible] | 1350 | SM | Silty fine sand, reddish/orange brn, ~~[illegible]~~ wet |
| | SB1- | 16.0 | 1.5 | | | | | | |
| | | | | | | TD = 16.5 sampled 15.0 drilled | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

NOTES:

BORING NO.: 10-574/575/576 SB-1

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# GEOLOGIC LOG

| | | | |
|---|---|---|---|
| PROJECT: UST Removal – Confirmation drilling | | SHEET 1 | BORING NO. SB2 |
| SITE LOCATION: Beale AFB 30th & A St (East 1944 (#155) (3) 12,000 gas tanks | JOB NO.: 126H-4230-004 | | |
| | LOCATION: North 10-494/495/-496 | GROUND ELEV. ~130 | TOTAL DEPTH 18 |
| DRILL CONTRACTOR: Turner Exp. | GEOLOGIST: Kathy | BEGUN: 0843 2/22/95 | |
| DRILL RIG: B-61 Mobile | DRILLER: Kevin | FINISHED: | |
| HOLE SIZE: 8 | WEATHER: Clear Cool 1015-overcast foggy | GROUND WATER (DEPTH/ELEV.): 80-90'msl / depth ~ 40-50' | |
| DRILLING METHOD: Hollow stem auger | DRILLING FLUID/SOURCE: N/A | TOP OF ROCK (DEPTH/ELEV.): | |

| DEPTH | SAMPLE TYPE/NO. | SAMPLE DEPTH | SAMPLE RECOVERY | BLOW COUNT (per 6 inches) | PERCENT RECOVERY | NOTES: PRODUCT ODOR, OVA MEASURMENT, ETC. | TIME LOG | USCS LOG | STRATIGRAPHIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | 0843 | ML | brn slightly moist clayey silt w/ fine sand |
| | | | | | | | | | increasing grain size some coarse mat'l grv up to sm pebble – "fine" % of cuttings |
| | 5.4' bgs 1033 | | | | | | | 7.5YR | |
| | | | | 19 | 1.1 | bh 0.0 bkgd. | 0847 | GC | brn slightly moist to strong brn |
| | wet | moist | (6) | 11 | 20.1 | after 1 min and climbing | | | mottled w/ decomp. clayey grv weathered |
| | SB2-6½ | on sleeve | mark sleeve | 25 | 0.0 | bh | 0858 | | tight thin wet sand/lense |
| | | | 75 | 20 | 3.4 | sample – Δfm 8½' | 905 | | |
| | | | 100 | 27 30 | 6.0 | bh | | | tight-friable silty cly slightly moist |
| | | | | 14, 16 | 0.0 | sample | 918 | CL | distinct mottled red brn y brn silty cl some blk speck |
| 10 | | | 100 | 16 | 0.0 | bh 10½ Δfm | | | |
| | | | 90 | 12 | 0.0 | sample 11' 11 | 0925 | CH | moist, light y brn cl some silt lense |
| | | | | 16 | 0.0 | | | 10YR | |
| | | | | 9 | 0.0 | 12½ ← Δfm? cuttings | 0937 | 7.5YR | brn slightly moist clayey silt |
| | SB2 13½ | | 60 | 13 | 0.0 | | | | non plastic (interbedded lens) |
| | | | | 10 | 0.0 | | 0947 | CL | Sleeve indicates same mat'l as 10½ → 12 |
| 15 | | | 45 | 9 | 0.0 | GP Δfm | | | |
| | | | | 14 | 0.0 | GC | 1000 | 7.5YR | slightly moist mottled |
| | | 28 | | 45 | 0.0 | GP Δfm | | CL-MH | silty clay → clayey silt |
| | | 35 | | 14 | 0.0 | dry" | 1010 | | |
| | SB2 18 | 50/5 | | 26 | | | | 7.5YR | Sand, clayey grv pebb. strong brn varicolored grains – vdc, mm |
| 20 | | | | 28 | | | | GP-GC GP | loose, angular, poorly sorted |
| 25 | | | | | | | | | |
| 30 | | | | | | TD @ 18' \| 5' screen | | 8 13 18 | 13' bm sand 18 — If annular sp can be bailed then a ¼" probe will be place @ 6' |

Left margin: continuous sampling; 15 — GP sat — 17.5; unsat

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

NOTES: 5½-6' moist – wet but tight does not release $H_2O$ (GC)
15-17½ wet and loose (GP)

BORING NO.: SB2

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# GEOLOGIC LOG

| | | | |
|---|---|---|---|
| PROJECT: Beale UST removal and confirm. 12614 | | SHEET 1 | BORING NO. SB3 |
| SITE LOCATION: Beale AFB 30th & A (east) N ← SB2 SB1 SB3 SB4 | JOB NO.: 4230-004 LOCATION: 10-494/10-495/10-496 | GROUND ELEV. ~130 | TOTAL DEPTH 6 backfill w/ bent |
| DRILL CONTRACTOR: Turner Exp. | GEOLOGIST: Katz | BEGUN: 1337 | |
| DRILL RIG: B-61 Mobile | DRILLER: Kevin / Leo | FINISHED: 1410 (backfilled @ 1520) | |
| HOLE SIZE: 8 | WEATHER: warm, overcast | GROUND WATER (DEPTH/ELEV.): ~15' | |
| DRILLING METHOD: Hollow Stem Auger | DRILLING FLUID/SOURCE: NA | TOP OF ROCK (DEPTH/ELEV.): | |

| DEPTH | SAMPLE TYPE/NO. | SAMPLE DEPTH | SAMPLE RECOVERY | BLOW COUNT (per 6 inches) | PID READING | NOTES: PRODUCT ODOR, OVA MEASURMENT, ETC. | TIME LOG | USCS LOG | STRATIGRAPHIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | manure odor from pile | 1337 1339 | ML GC GP SP | slightly moist brn, weathered, → strong brn, subrd-ang gravel - pebb some clay & silt, sand & GC-GP → SM → SP from 2 → 4½ ft |
| | | | | | | — 0 fm | | | |
| 1416 ▽ | | | | | | | | | |
| | | | | 30 | 17.1 | bh 17.1+ | 1344 | | Stop for sample (wet sleeve) |
| initial 5 to for sample | SB3-5½ | SS | | 36 | 194+ | water in amber jar | 1400 | | "foul smell" |
| | | | | 32 | climbing | | | | collect water sample (1358) |
| | | | | | 8-10 | 0 in bh w/auger out | | | and soil (1344) |
| | | | | | 20.2 | sample sleeve | | | |
| 10 | | | | | | | | | poor sampler recovery (<35%) (Not sure whether sleeve intv. 5½-6 was fully saturated. |
| | | | | | | | | | Color was consistent — Rbrn → strong brn → mottled brn w/ other borings. |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

NOTES: Backfilled @ 1520

BORING NO.: SB3

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# GEOLOGIC LOG

| | | | |
|---|---|---|---|
| PROJECT: Beale AFB UST Removal & Confirm. Drill. 12014 | JOB NO.: 4230-004 | SHEET 1 | BORING NO. SB4 |
| SITE LOCATION: 30th & A East 10-494/10-495/10-496 | LOCATION: E/o SB3, SE of SB2 E/o SB1 | GROUND ELEV. ~130 | TOTAL DEPTH 6.5 Backfill w/ ... |
| DRILL CONTRACTOR: | GEOLOGIST: Katy | BEGUN: 1443 2/22/95 | |
| DRILL RIG: | DRILLER: Kevin / Leo | FINISHED: 1513 " | |
| HOLE SIZE: 8" | WEATHER: warm clear | GROUND WATER (DEPTH/ELEV.): ~15' perched / ~40' WT | |
| DRILLING METHOD: split spoon Hollow Stem Auger | DRILLING FLUID/SOURCE: N/A | TOP OF ROCK (DEPTH/ELEV.): | |

| DEPTH | SAMPLE TYPE/NO. | SAMPLE DEPTH | SAMPLE RECOVERY | BLOW COUNT (per 6 inches) | PID READING | NOTES: PRODUCT ODOR, OVA MEASURMENT, ETC. | TIME LOG | USCS LOG | STRATIGRAPHIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | 1443 | 1445 | 7.5YR | RBrn – strong brn ~~Strong brn~~ silty clay moist – slightly moist CL CH |
| | | | | | | | 1446 | | – grv hint but nothing in cuttings |
| | | | | | | Phew! | | | ybrn mottle w/ rd brn |
| | | | | 8 | 0.0 in bh | | 1450 | ML | – silty clay → clayey silt |
| 5 | SB4-6 | | 80 | 10 | 150+ | in sample sleeve | | | slightly moist, |
| | | | | 16 | | | | | green but @ 5 ft 0.0 PID however |
| | | | | | | | 1 | GC Gley 6/1 | Greenish gray matrix – silty sand some clay w/~20% gravels tight – moist to wet in few places slightly moist |
| 10 | | | | | | | | | |
| | | | | | | | | | Sample sleeve appeared wet on exterior but samples were mostly slightly moist to moist. |
| 15 | | | | | | | | | |
| | | | | | | | | | Water appears @ very base of sampler hole ~2" or less. Moisture appeared primarily between 5-5½' and decreased to 6½ where it was slightly moist. |
| 20 | | | | | | | | | ∴ water @ base may be from seepage and not another "zone". |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

NOTES: Backfilled
Munsell color recorded for stained mat'l

BORING NO.: SB4

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# GEOLOGIC BORING LOG

| | | | |
|---|---|---|---|
| PROJECT: Beale UST Confirmation | | SHEET 1 | BORING NO. SB5 |
| SITE LOCATION: 30th & A Sts. E/o SB3 & SB4 near drain ditch | JOB NO.: 12614 4230-004 | | |
| | LOCATION: 10-494/10-495/10-496 | GROUND ELEV. ~130' | TOTAL DEPTH 11 |
| DRILL CONTRACTOR: Turner Const. | GEOLOGIST: Katz | BEGUN: 845 | back 1530 |
| DRILL RIG: B-61 | DRILLER: Kevin ... | FINISHED: 0955 | |
| HOLE SIZE: 8" | WEATHER: overcast, foggy; mild; 0930 sun peaks thru | GROUND WATER (DEPTH/ELEV.): | |
| DRILLING METHOD: HSA | DRILLING FLUID/SOURCE: NA | TOP OF ROCK (DEPTH/ELEV.): | |

continuous sampling

| DEPTH | SAMPLE TYPE/NO. | SAMPLE DEPTH | SAMPLE RECOVERY | BLOW COUNT (per 6 inches) | PERCENT RECOVERY | NOTES: PRODUCT ODOR, OVA MEASUREMENT, ETC. | TIME LOG | USCS LOG | STRATIGRAPHIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | 0848-850! bkgrd PID@ 5.5-5.7 | 0849 | | strong brn - dk brn soil/grass clayey silt some f. sand 7.5YR brn - appears mottled 5/4 w/ yb & Rb = brn |
| | | | | | | | | ML SM | |
| 5 | SB5-5 | | 85 | 7, 36, 20 | | 5.4 bkgd; 20.8 1 min shoe | 0852 4.7 | GC GP | first sign/sound of grv. brn hue/varied colors weathered lg-med pebb. clayey grv. grading to (some silt) c.s. grv. |
| | SB5-6½ | | 100 | 19, 36, 45 | | 5.8 bkgd.; 14.1 shoe | 0909 | | wet shoe only |
| | SB5-8 | | | | 14.5 | 5.4 bk | 0921 | GP | isolated places of sat. overall sample spoon is not v. moist. weathered clasts are green |
| | SB5-9 | | 90 | 21, 19, 20, 6 | 11.9 | 9.2 bk | 0930 | ML | plastic where wet & strong brn |
| 10 | | | 35 | 7, 11 | 21.5 | shoe | | | ybrn silty f.cl & rb w/ blk spots. |
| | SB5-11 | | | 3, 7, 11 | 25.1 | 4.5 bk gd. shoe | 0943 | ML | 35% recov — loose, dry, silty |
| | | | | | | | | | Term. boring @ 11'; backfill w/ grout |
| 15 | | | | | | | 1000 | | review site layout w/ Rodney and select SB6 locat → S/o tanks |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

... sample ... but most is dry

| | | |
|---|---|---|
| SAMPLE TYPES SS=SPLIT SPOON, ST=SHELBY TUBE R=ROCK CORE, O=OTHER | NOTES: Drilled 11' w/o apparent contam. Backfill w/ grout nevertheless. Done 1530 | BORING NO.: SB5 |

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# GEOLOGIC BORING LOG

| | | | |
|---|---|---|---|
| PROJECT: UST Removal & confirmation drilling 12614 | | SHEET 1 | BORING NO. SB6 |
| SITE LOCATION: Beale AFB 30th & A Sts East | JOB NO.: 4230-004 | | |
| | LOCATION: 10-494/495/496 South of USTs, south end of compost pile | GROUND ELEV. ~130' | TOTAL DEPTH 6 |
| DRILL CONTRACTOR: Turner Exp | GEOLOGIST: Katy | BEGUN: 1047 | |
| DRILL RIG: B-61 Mobile | DRILLER: Kevin w/ Ted | FINISHED: 1430 | |
| HOLE SIZE: 8" | WEATHER: overcast clearing @ 1130 | GROUND WATER (DEPTH/ELEV.): | |
| DRILLING METHOD: HSA | DRILLING FLUID/SOURCE: NA | TOP OF ROCK (DEPTH/ELEV.): | |

continuous sampling

| DEPTH | SAMPLE TYPE/NO. | SAMPLE DEPTH | SAMPLE RECOVERY | BLOW COUNT (per 6 inches) | PERCENT RECOVERY | NOTES: PRODUCT ODOR, OVA MEASURMENT, ETC. | TIME LOG | USCS LOG | STRATIGRAPHIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | stc 1030 |
| 0 | | | | | | bkgd PID 4.1 | 1049 | | |
| | | | | | 1430 | | | ML | strong brn cly silt some f.s. soft moist light |
| | | | | | @ | | | | 1st sign of grv. "sound" |
| | SB6-4 | 4.5 | | 8 | | 2.2 bkgd 10.6 shoe | 1053 | GM | wet in shoe only → 4.2'→4.5 |
| | shoe wet | | | 13 | | | | | |
| 5 | SB6-5½ | | | 24, 20, 21 | | 2.2 bk bhe 2.2 | | GP | shoe sat w/ fp |
| | | | | | | 1333 Alarm! 2500 max reading was reached | 1104 | | samples in sleeve(s) do not appear completely sat, samples once broken appear slightly moist w/ wet areas. |
| 10 | | | | | | | | | spoon appears wet. product seeped from walls, both collected samples @ 5' & 6' ... in baggies |
| 15 | | | | | | | | | Move to SB7 @ 1130 |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

| | | |
|---|---|---|
| SAMPLE TYPES SS=SPLIT SPOON, ST=SHELBY TUBE R=ROCK CORE, O=OTHER | NOTES: Back fill this afternoon 1430 done | BORING NO.: SB6 |

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Engineers

# GEOLOGIC BORING LOG

| | | | |
|---|---|---|---|
| PROJECT: Beale UST removal & confirmation 12614 | | SHEET: 1 | BORING NO. SB7 |
| SITE LOCATION: 30th & A E/o SB6 S/o SB5 | JOB NO.: 4230 | | |
| | LOCATION: 10-494/10-495/10-496 | GROUND ELEV. ~130 | TOTAL DEPTH 11½ |
| DRILL CONTRACTOR: Turner Expl. | GEOLOGIST: Katy | BEGUN: 1150 | |
| DRILL RIG: B-61 Mobile | DRILLER: Kevin w/ Sco | FINISHED: 1356 ~~1530~~ | |
| HOLE SIZE: 8" | WEATHER: Clear, slight breeze | GROUND WATER (DEPTH/ELEV.): | |
| DRILLING METHOD: HSA | DRILLING FLUID/SOURCE: N/A | TOP OF ROCK (DEPTH/ELEV.): | |

| DEPTH | SAMPLE TYPE/NO. | SAMPLE DEPTH | SAMPLE RECOVERY | BLOW COUNT (per 6 inches) | PERCENT RECOVERY | NOTES: PRODUCT ODOR, OVA MEASURMENT, ETC. | TIME LOG | USCS LOG | STRATIGRAPHIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | 1150 0.0 bkgrnd | | ML | |
| | | | | 18 36 30 | | 0.0 shoe | 1158 | GM | "sound" of grv. slightly moist, highly weathered pebb, dug. strong brn - red brn |
| 5 | SB7--5½ | | 95 | 16, 18, 31 | | stinks! 1100+ in shoe | 1208 | GM | Dark gray & green discoloration mottle. not uniform as was SB4 at similar depth. Slightly moist |
| | | | 95 | 17 24 28 | | 82 ~~top~~ end | 1235 | | |
| | | No sample | | misunderstanding in sampling every ft. | | | 1250 | | Decide to to continue since soil is essentially dry. |
| 10 | | | | 7 17 30 | | 0.2 ppm<br>9.1 ppm<br>34 ppm splits between sleeves<br>6' ↓ 7½ | 1310 | GP ↓ GM | mat'l in shoe missing<br>mid sleeve sat w/ 1495 ppm<br>midway in lower shoe ~~is~~ relatively dry to moist |
| | SB7-11½ | | | 9 13 for 3 | | ~~1317~~<br>3" sample 0.4 ppm<br>slightly moist Not wet | 1317 | | cuttings at 7' ~ 307 ppm<br>borehole @ 649 + 7½' dry bit |
| 15 | | | | | | 9' | | yb SM | bit dry PID @ ~50 bh @ 47 |
| | | | | | | 91 ppm in shoe<br>10½ | | ↓ GM brn dark gray pebb | 9-10½ interval is sandy grv little cl or silt, mottled black specs. |
| 20 | | | | | | | | | Drilled to 10½, lifted bit to continue sampling — as bit surfaced it appeared "wet". requested the he get me a 2" sample for verification — No sig. moisture |
| 25 | | | | | | | | | Will collect sample 10½-11½ for lab analysis & verification |
| | | | | | | | 1321 | | Sampled 9" → 11½ |
| 30 | | | | | | | 1331 | | WL @ 8.7 bgs |

Zodiac bh [illegible] Lower@ 630

Mary from Yuba arrived @ 1420 after grout.

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

NOTES: Pellets added handful @ a time to borehole, total one bag; cement slurry (w/ bent powder) use to finish backfill.

BORING NO.: SB7

# APPENDIX C

# LABORATORY ANALYTICAL DATA

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# ANALYTICAL REPORT

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 18-MAR-96
Lab Job Number: 124633
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Susan K Morrison

Reviewed by:

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Curtis & Tompkins, Ltd

**Laboratory Number: 124633**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 02/27/96**
**Receipt Date:02/28/96**

**CASE NARRATIVE**

Curtis & Tompkins Ltd. received five soil samples from the above referenced project on Feb.28,1996. All samples were received cold and intact. Chromatograms are included in this report for any samples containing quantifiable concentrations of hydrocarbons, along with an example chromatogram for each type of fuel standard.The following analytical problems were encountered:

**TPH/D:** No analytical problems.

**TPH/G:** Sample chromatograms do not resemble Curtis & Tompkins' gasoline standard, but are similar to a JP-4 standard which is occasionally requested.

**BTXE:** The qualifier "C" flag appears with results for samples BE-MP14-7 (C&T# 124633-004) and BE-MP22-7 (C&T# 124633-005). This flag indicates that the target compound was confirmed by a second analytical column, but that the quantitated result on the confirmation column differed from the reported result by more than a factor of two. This often happens when the observed hydrocarbon pattern does not resemble gasoline, which is the case with this sample set. The matrix spike and spike duplicate failed ethylbenzene and m,p-xylene recovery limits. The spiked sample was not from Beale AFB. The associated laboratory control sample passed all acceptance criteria.

## TEH-Tot Ext Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | LUFT |
| Location: | Beale AFB | | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124633-001 | BE-MP09-6 | 26268 | 02/27/96 | 03/05/96 | 03/09/96 | 14% |
| 124633-002 | BE-MP12-4 | 26268 | 02/27/96 | 03/05/96 | 03/09/96 | 16% |
| 124633-003 | BE-MP13-6.5 | 26268 | 02/27/96 | 03/05/96 | 03/09/96 | 14% |
| 124633-004 | BE-MP14-7 | 26268 | 02/27/96 | 03/05/96 | 03/09/96 | 15% |

| Analyte<br>Diln Fac: | Units | 124633-001<br>1 | 124633-002<br>1 | 124633-003<br>1 | 124633-004<br>1 |
|---|---|---|---|---|---|
| JP5 | mg/Kg | 2.3 | <1.2 | 7 Y | 55 Y |
| Diesel Range | mg/Kg | 8.8YH | <1.2 | 4.7YL | 33 YL |
| Motor Oil Range | mg/Kg | 15 YL | <6 | <5.8 | 21 YL |
| **Surrogate** | | | | | |
| Hexacosane | %REC | 99 | 93 | 92 | 94 |

Y: Sample exhibits fuel pattern which does not resemble standard
H: Heavier hydrocarbons than indicated standard
L: Lighter hydrocarbons than indicated standard

## TEH-Tot Ext Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: LUFT |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124633-005 | BE-MP22-7 | 26268 | 02/27/96 | 03/05/96 | 03/09/96 | 20% |

| Analyte<br>Diln Fac: | Units | 124633-005<br>1 | |
|---|---|---|---|
| JP5 | mg/Kg | 340 | YH |
| Diesel Range | mg/Kg | 500 | YL |
| Motor Oil Range | mg/Kg | 23 | YL |
| **Surrogate** | | | |
| Hexacosane | %REC | 84 | |

Y: Sample exhibits fuel pattern which does not resemble standard
H: Heavier hydrocarbons than indicated standard
L: Lighter hydrocarbons than indicated standard

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Lab #: 124633 BATCH QC REPORT 

| TEH-Tot Ext Hydrocarbons | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | LUFT |
| Location: | Beale AFB | | |

| METHOD BLANK | | | |
|---|---|---|---|
| Matrix: | Soil | Prep Date: | 03/05/96 |
| Batch#: | 26268 | Analysis Date: | 03/08/96 |
| Units: | mg/Kg | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC16519

| Analyte | Result | |
|---|---|---|
| JP5 | <1.0 | |
| Diesel Range | <1.0 | |
| Motor Oil Range | <5.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 69 | 60-140 |

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## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: LUFT

## LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26268
Units: mg/Kg
Diln Fac: 1

Prep Date: 03/05/96
Analysis Date: 03/08/96

LCS Lab ID: QC16520

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Diesel Range | 40.1 | 49.5 | 81 | 60-140 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 69 | 60-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

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Lab #: 124633 | BATCH QC REPORT | 

## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: LUFT

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124641-004
Matrix: Soil
Batch#: 26268
Units: mg/Kg dry weight
Diln Fac: 1

Sample Date: 02/27/96
Received Date: 03/01/96
Prep Date: 03/05/96
Analysis Date: 03/08/96
Moisture: 35%

MS Lab ID: QC16521

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Diesel Range | 76.15 | <1.538 | 71.69 | 94 | 60-140 |
| Surrogate | %Rec | Limits | | | |
| Hexacosane | 82 | 60-140 | | | |

MSD Lab ID: QC16522

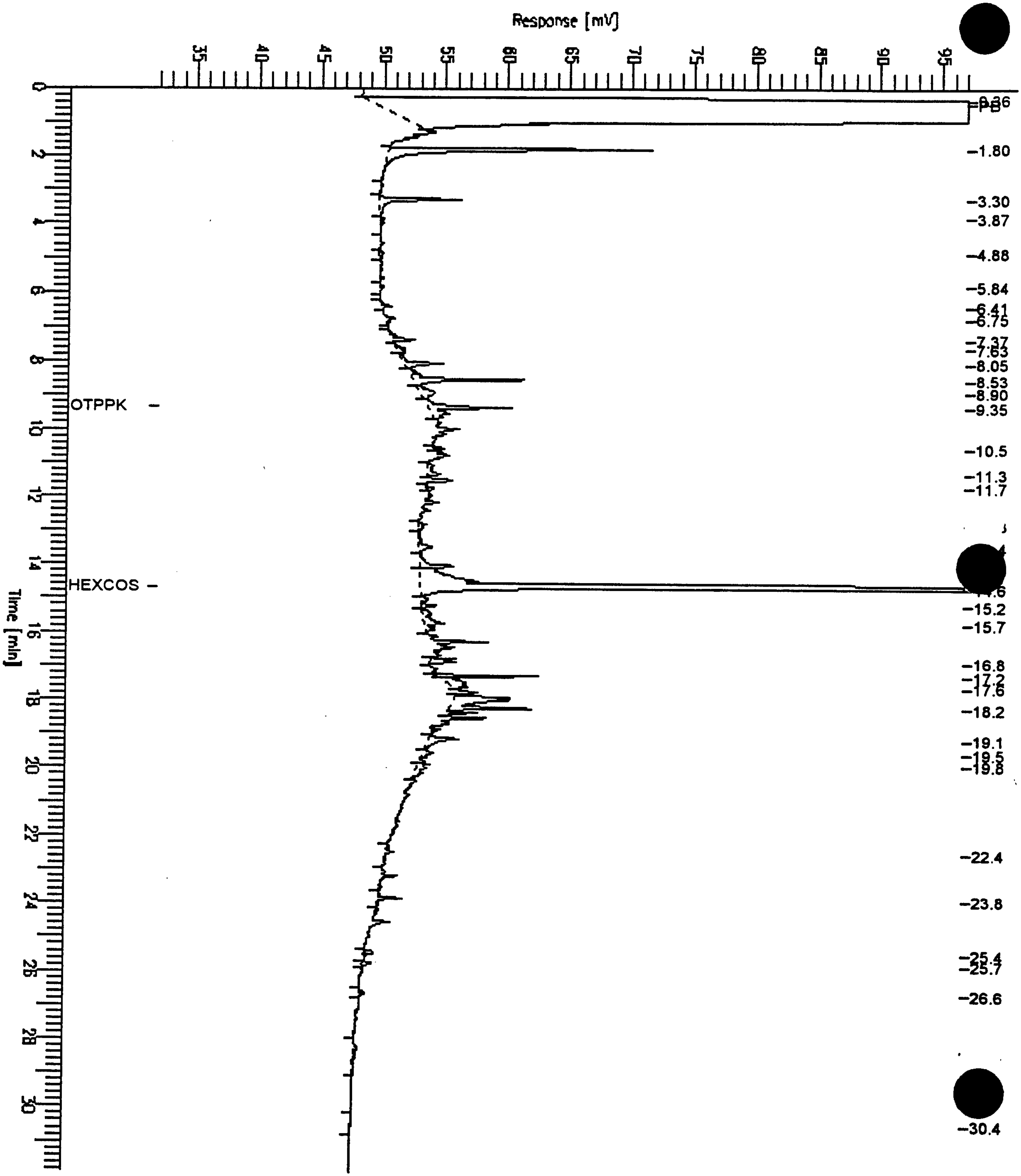
| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Diesel Range | 76.15 | 63.54 | 83 | 60-140 | 12 | <30 |
| Surrogate | %Rec | Limits | | | | |
| Hexacosane | 74 | 60-140 | | | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

# GC15 Channel A Surrogate

Sample Name : S,124633-001,26268
FileName : C:\GC15\CHB\068B015.raw
Method : DUAL
Start Time : 0.00 min End Time : 31.90 min
Scale Factor: 0.0 Plot Offset: 32 mV

Sample #: 26268 Page 1 of 1
Date : 3/9/96 03:48 AM
Time of Injection: 3/9/96 03:15 AM
Low Point : 32.00 mV High Point : 97.00 mV
Plot Scale: 65.0 mV

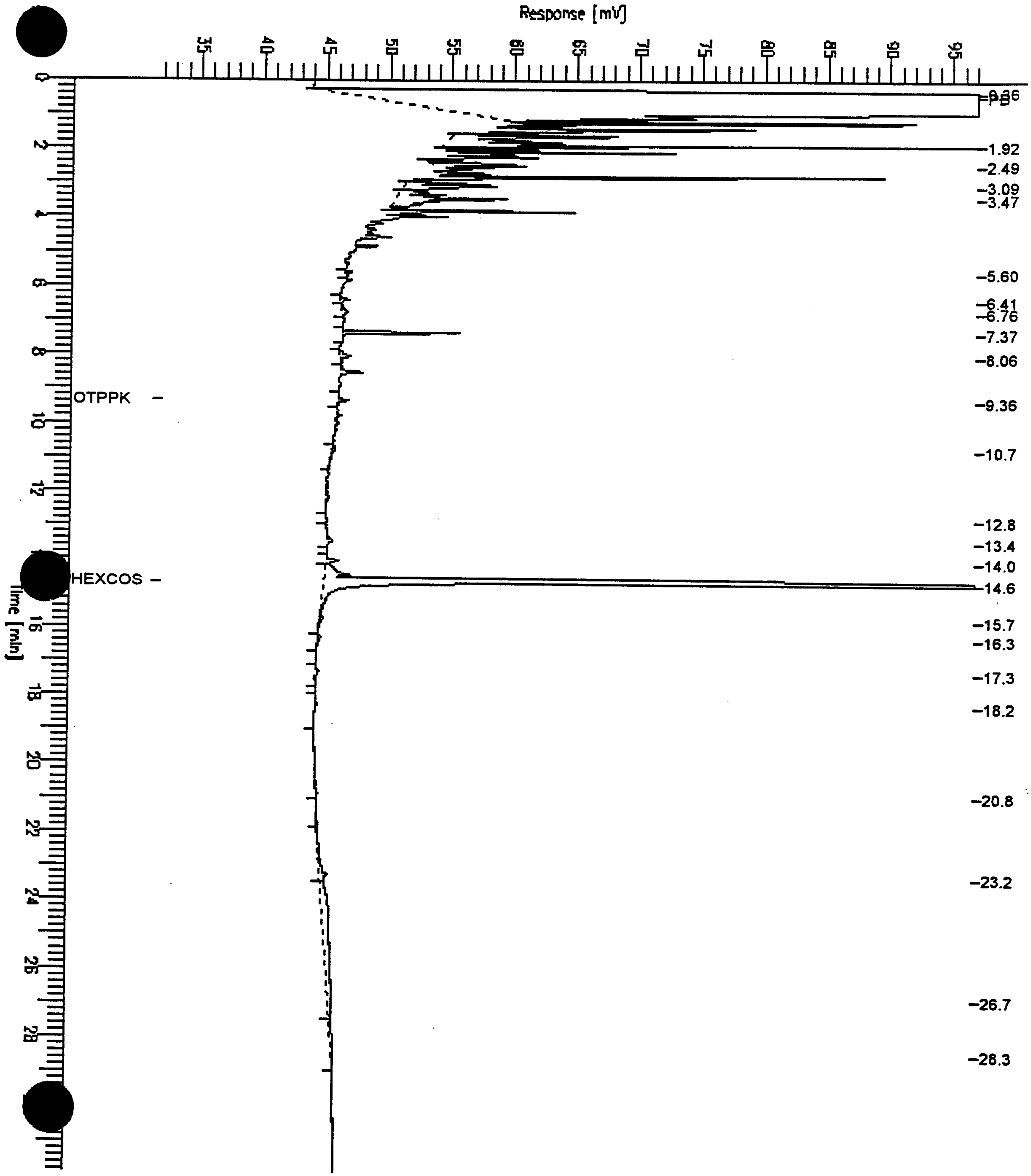


# GC15 Channel A Surrogate

Sample Name : S,124633-003,26268
FileName : C:\GC15\CHB\068B012.raw
Method : DUAL
Start Time : 0.00 min
End Time : 31.90 min
Plot Offset: 32 mV
Scale Factor: 0.0

Sample #: 26268
Date : 3/9/96 01:37 AM
Time of Injection: 3/9/96 01:04 AM
Low Point : 32.00 mV
High Point : 97.00 mV
Plot Scale: 65.0 mV

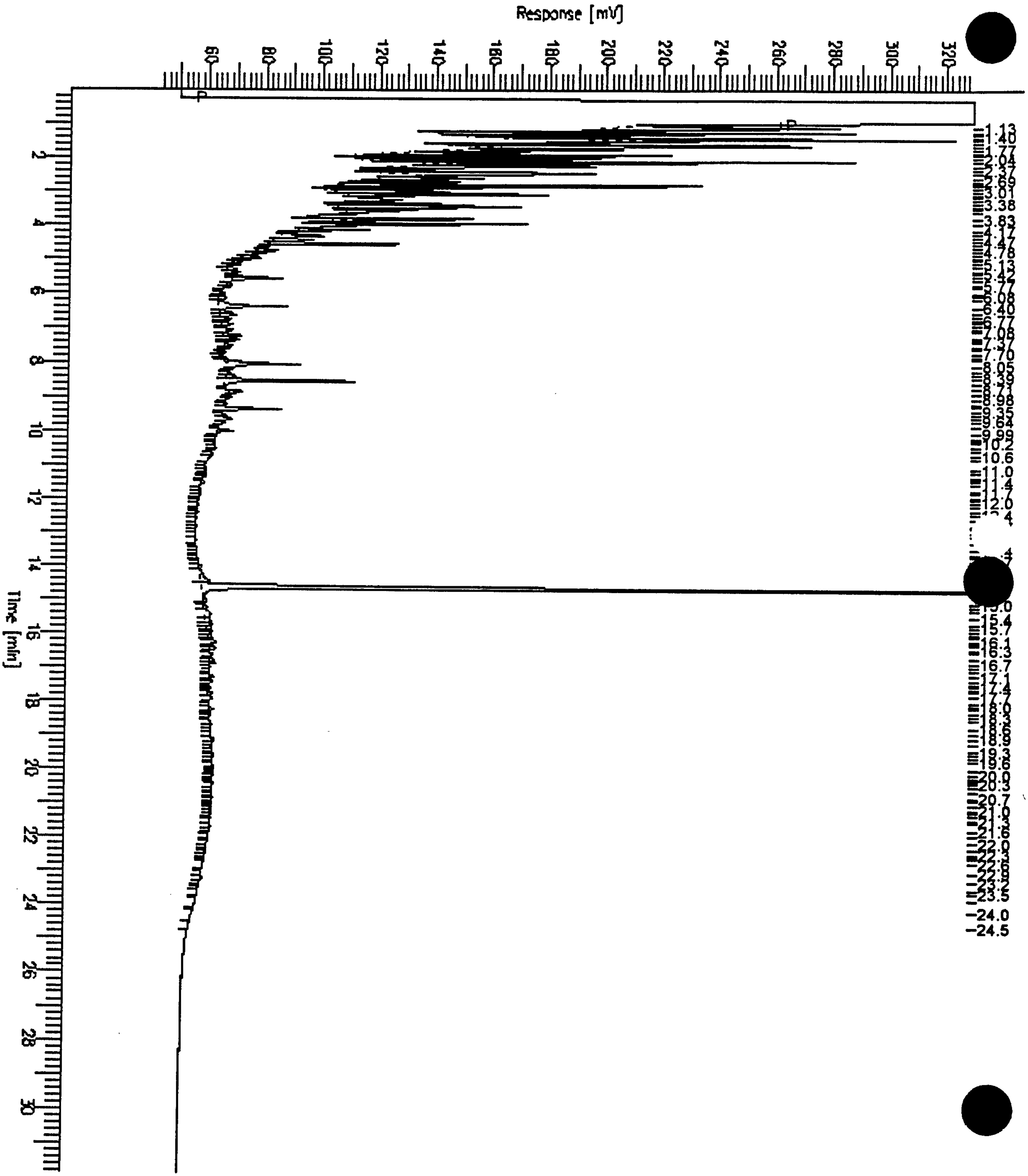




# GC15 Channel A TEH

Sample Name : S,124633-004,26268
FileName : C:\GC15\CHB\068B021.RAW
Method : BTEH.MTH
Start Time : 0.01 min End Time : 31.91 min
Scale Factor: 0.0 Plot Offset: 43 mV

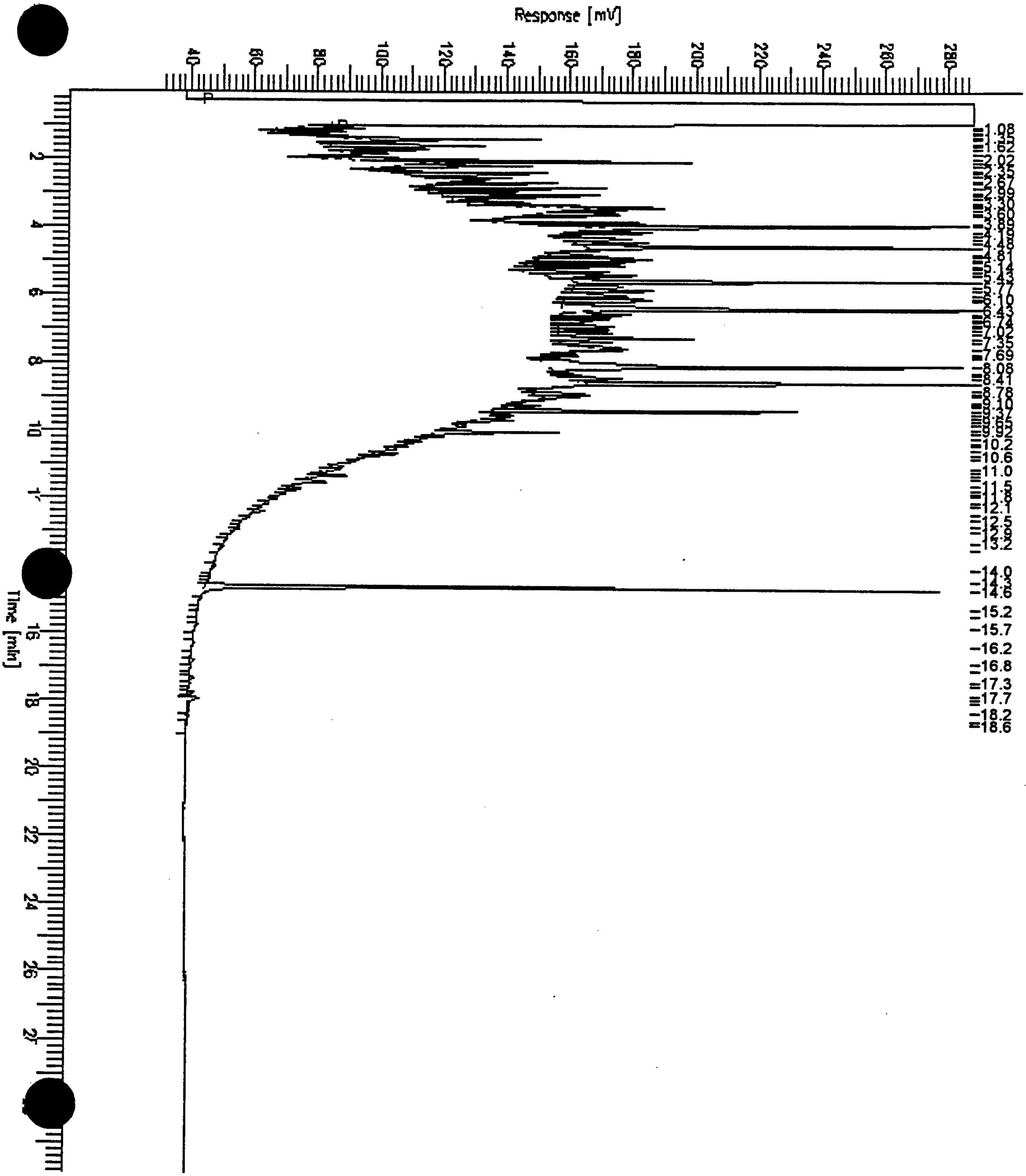
Sample #: 26268 
Date : 3/11/96 03:50 PM
Time of Injection: 3/9/96 07:38 AM
Low Point : 43.06 mV High Point : 329.56 mV
Plot Scale: 286.5 mV



# GC15 Channel A TEH

Sample Name : S,124633-005,26268
FileName : C:\GC15\CHB\071B005.RAW
Method : BTEH.MTH
Start Time : 0.01 min
End Time : 31.91 min
Factor: 0.0
Plot Offset: 30 mV

Sample #: 26268
Page 1 of 1
Date : 3/11/96 06:32 PM
Time of Injection: 3/11/96 05:11 PM
Low Point : 30.24 mV
High Point : 287.89 mV
Plot Scale: 257.7 mV

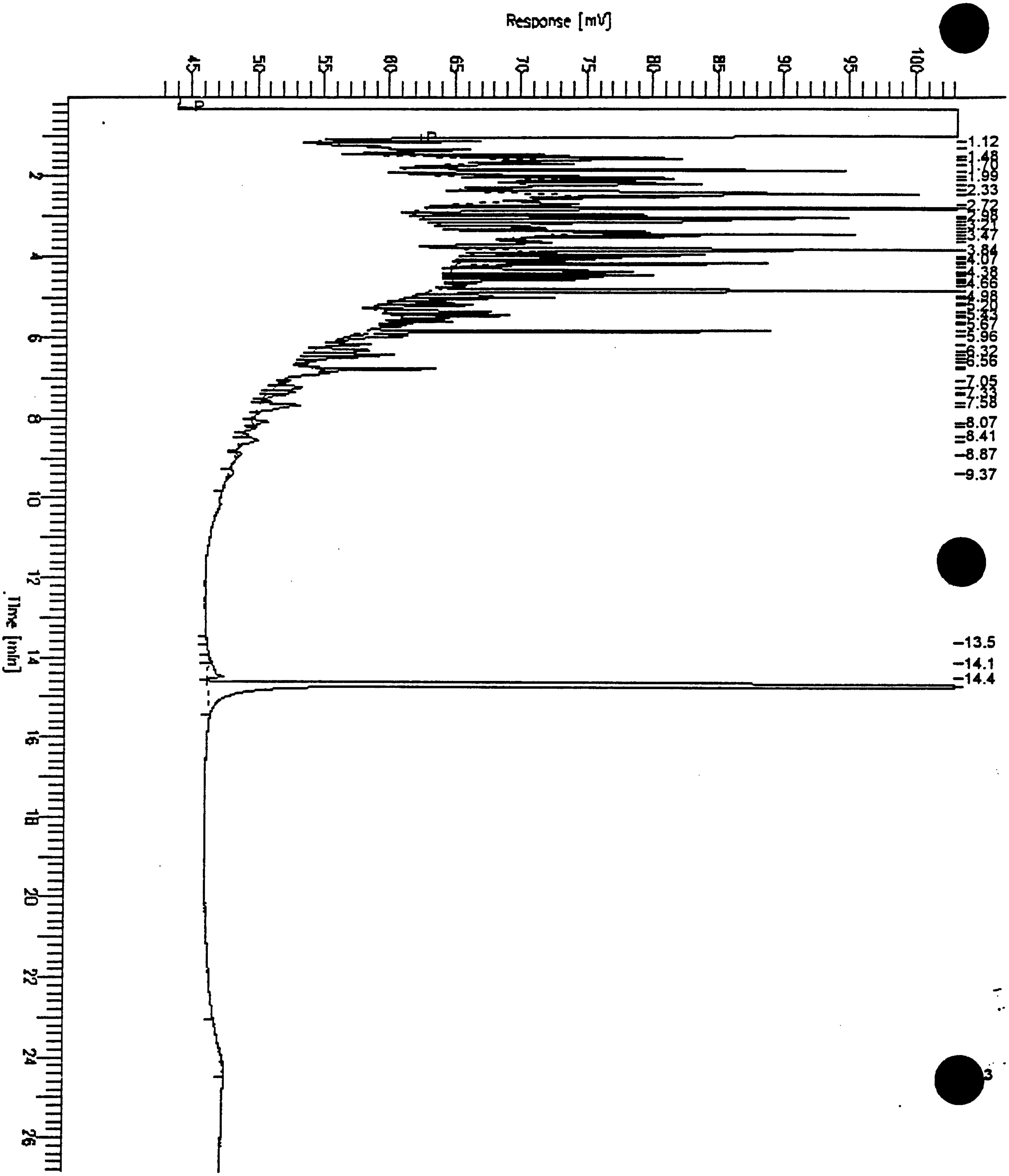


JP-5

# GC15 Channel A TEH

Sample Name : CCV,JP5
FileName : C:\GC15\CHB\067B023.RAW
Method : BTEH.MTH
Start Time : 0.01 min    End Time : 26.87 min
Scale Factor: 0.0    Plot Offset: 42 mV

Sample #: 250MG/L    Page 1 of 1
Date : 3/8/96 01:50 PM
Time of Injection: 3/8/96 07:20 AM
Low Point : 42.42 mV    High Point : 103.22 mV
Plot Scale: 60.8 mV




3

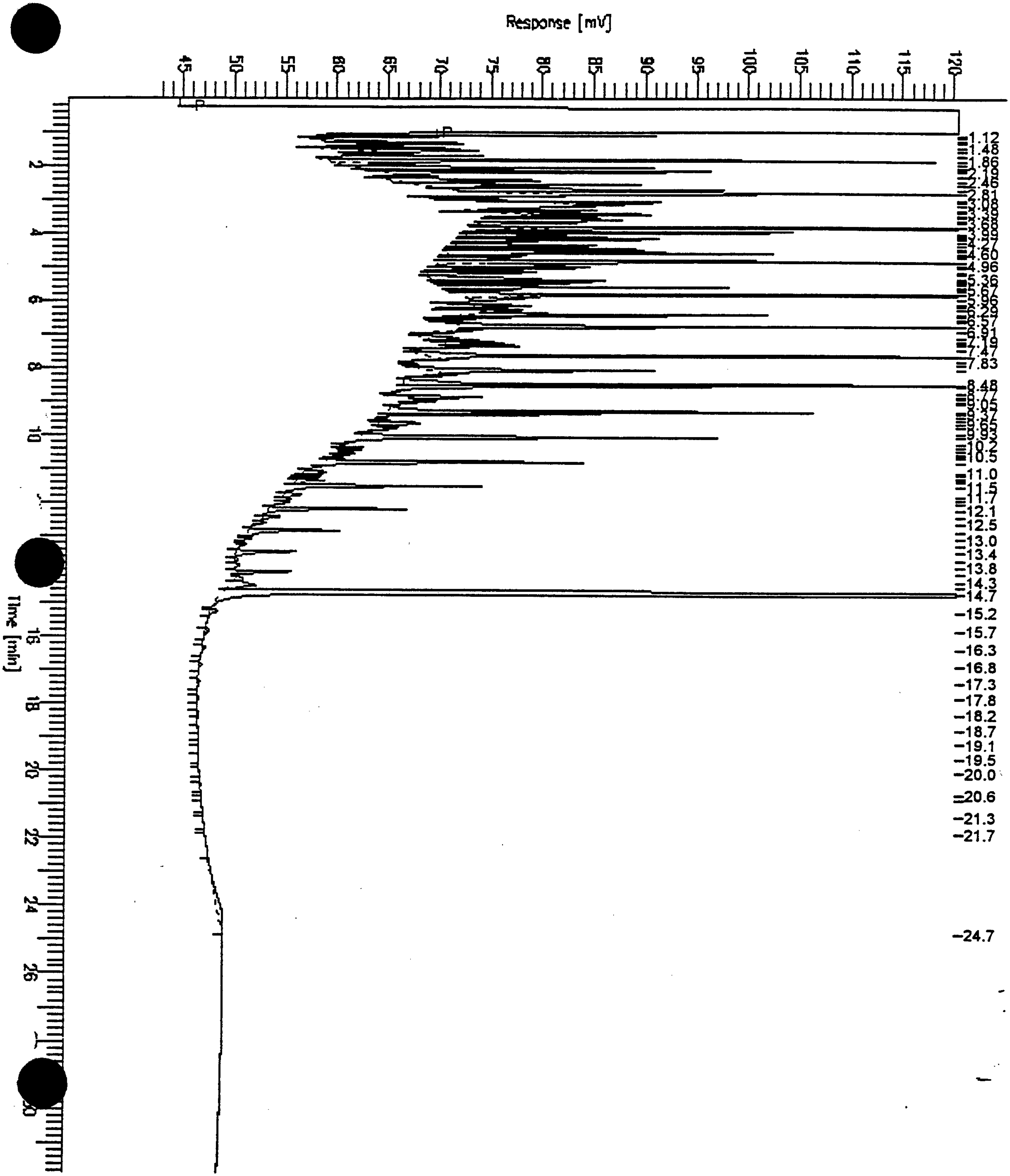
Diesel

# GC15 Channel A TEH

Sample Name : CCV,96WS1948,DSL
FileName : C:\GC15\CHB\067B021.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Factor: 0.0
End Time : 31.91 min
Plot Offset: 42 mV

Sample #: DSL
Date : 3/8/96 01:45 PM
Time of Injection: 3/8/96 05:52 AM
Low Point : 42.49 mV
High Point : 120.49 mV
Plot Scale: 78.0 mV



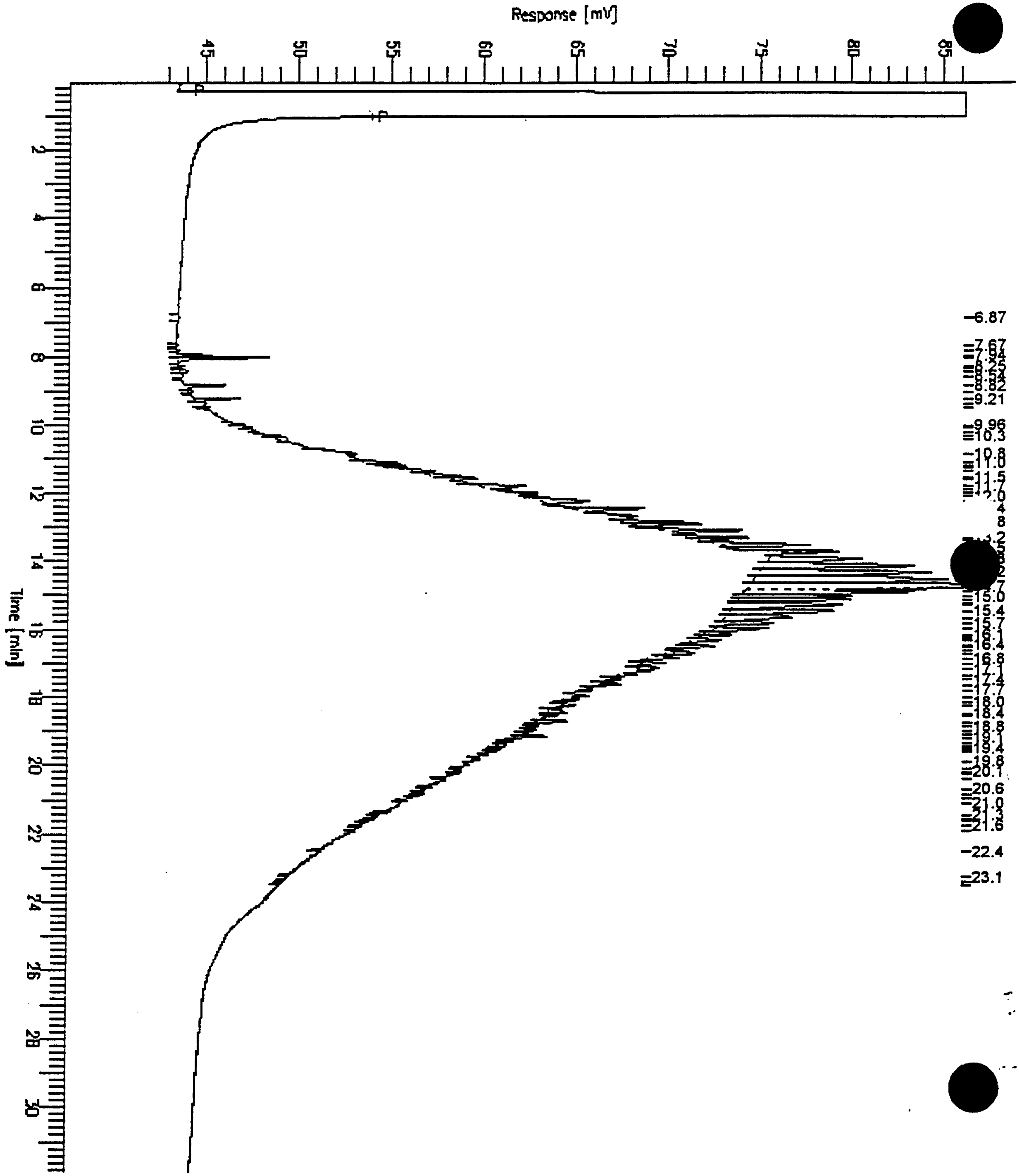


# GC15 Channel A TEH

motor oil

Sample Name : MO 95WS/596 500mg/L
FileName : C:\GC15\CHB\067B008.RAW
Method : BTEH.MTH
Start Time : 0.01 min    End Time : 31.91 min
Scale Factor: 0.0    Plot Offset: 42 mV

Sample #:    Page 1 of 1
Date : 3/8/96 02:01 PM
Time of Injection: 3/7/96 08:23 PM
Low Point : 42.50 mV    High Point : 86.16 mV
Plot Scale: 43.7 mV



## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124633-001 | BE-MP09-6 | 26345 | 02/27/96 | 03/12/96 | 03/12/96 | 14% |
| 124633-002 | BE-MP12-4 | 26345 | 02/27/96 | 03/12/96 | 03/12/96 | 16% |
| 124633-003 | BE-MP13-6.5 | 26345 | 02/27/96 | 03/12/96 | 03/12/96 | 14% |
| 124633-004 | BE-MP14-7 | 26345 | 02/27/96 | 03/12/96 | 03/12/96 | 15% |

| Analyte<br>Diln Fac: | Units | 124633-001<br>1 | 124633-002<br>1 | 124633-003<br>1 | 124633-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | mg/Kg | <1.2 | <1.2 | <1.2 | 21 Y |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 89 | 94 | 67 | 115 |
| Bromobenzene | %REC | 79 | 84 | 58 | 73 |

Sample exhibits fuel pattern which does not resemble standard

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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124633-005 | BE-MP22-7 | 26389 | 02/27/96 | 03/12/96 | 03/12/96 | 20% |

| Analyte | Units | 124633-005 |
|---|---|---|
| Diln Fac: | | 25 |
| Gasoline | mg/Kg | 44 YH |
| Surrogate | | |
| Trifluorotoluene | %REC | 92 |
| Bromobenzene | %REC | 65 |

Y: Sample exhibits fuel pattern which does not resemble standard
H: Heavier hydrocarbons than indicated standard

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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

### METHOD BLANK

Matrix: Soil
Batch#: 26389
Units: mg/Kg
Diln Fac: 1

Prep Date: 03/12/96
Analysis Date: 03/12/96

MB Lab ID: QC16980

| Analyte | Result | |
|---|---|---|
| Gasoline | <1.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 96 | 52-127 |
| Bromobenzene | 85 | 47-112 |

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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

## LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26345
Units: mg/Kg
Diln Fac: 1

Prep Date: 03/11/96
Analysis Date: 03/11/96

LCS Lab ID: QC16892

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 10.1 | 10 | 101 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 106 | 52-127 |
| Bromobenzene | 90 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124634-001 | BE-MP15-9.5 | 26389 | 02/27/96 | 03/12/96 | 03/12/96 | 10% |
| 124634-002 | BE-MP10-5.5 | 26389 | 02/28/96 | 03/12/96 | 03/12/96 | 10% |
| 124634-003 | BE-MP11-7.0 | 26389 | 02/28/96 | 03/12/96 | 03/12/96 | 12% |
| 124634-004 | BE-MP19-7.0 | 26345 | 02/28/96 | 03/12/96 | 03/12/96 | 9% |

| Analyte<br>Diln Fac: | Units | 124634-001<br>1 | 124634-002<br>200 | 124634-003<br>25 | 124634-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | mg/Kg | 22 Y | 780 YH | 40 YH | <1.1 |
| Surrogate | | | | | |
| Trifluorotoluene | %REC | 90 | 109 | 67 | 89 |
| Bromobenzene | %REC | 68 | 77 | 56 | 78 |

Y: Sample exhibits fuel pattern which does not resemble standard
H: Heavier hydrocarbons than indicated standard

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## TVH-Total Volatile Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

### METHOD BLANK

| | | | |
|---|---|---|---|
| Matrix: | Soil | Prep Date: | 03/11/96 |
| Batch#: | 26345 | Analysis Date: | 03/11/96 |
| Units: | mg/Kg | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC16891

| Analyte | Result | |
|---|---|---|
| Gasoline | <1.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 93 | 52-127 |
| Bromobenzene | 78 | 47-112 |

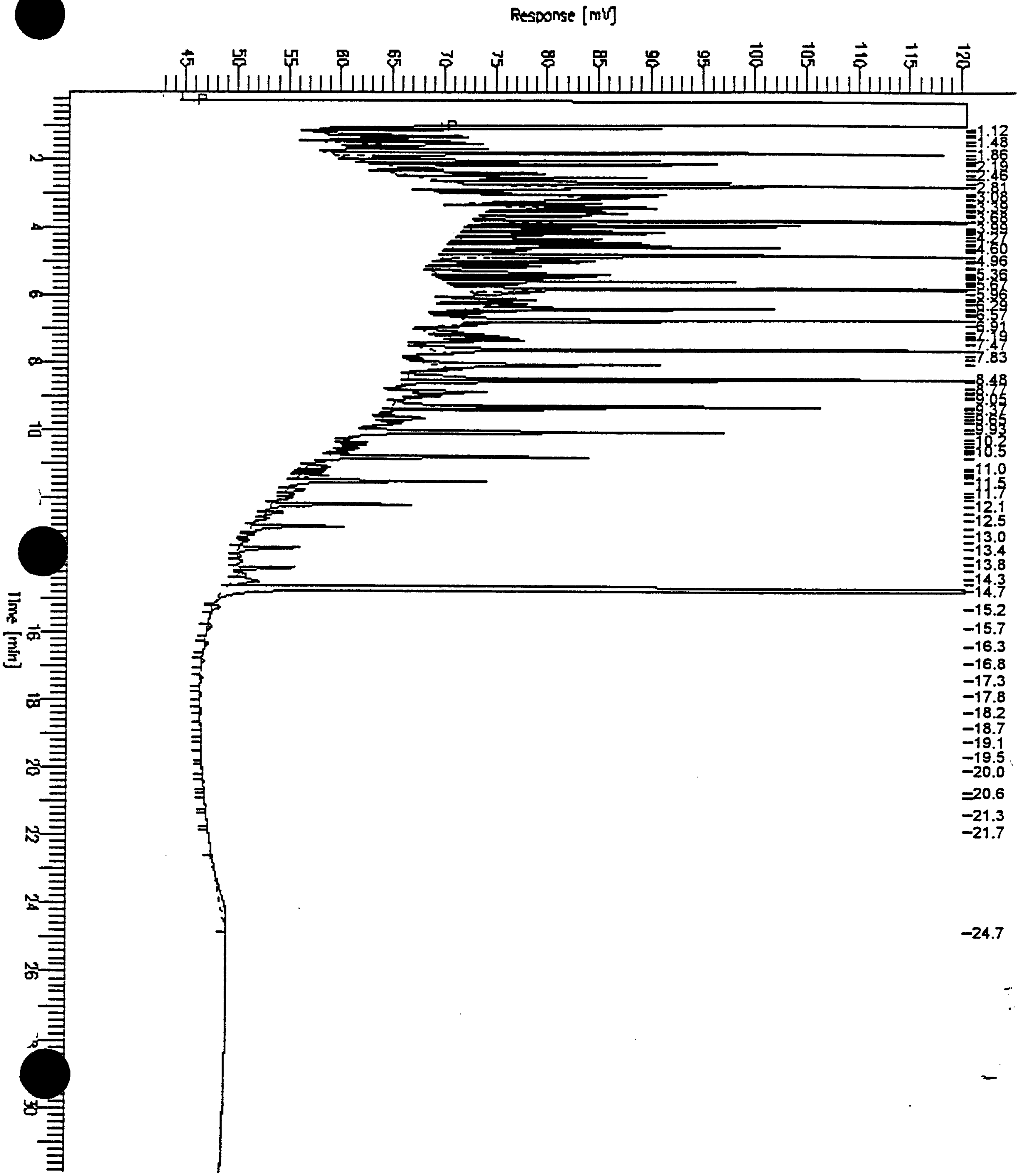
Diesel

# GC15 Channel A TEH

Sample Name : CCV,96WS1948,DSL
FileName : C:\GC15\CHB\067B021.RAW
Method : BTEH.MTH
` Time : 0.01 min
: Factor: 0.0
End Time : 31.91 min
Plot Offset: 42 mV

Sample #: DSL
Date : 3/8/96 01:45 PM
Time of Injection: 3/8/96 05:52 AM
Low Point : 42.49 mV
High Point : 120.49 mV
Plot Scale: 78.0 mV



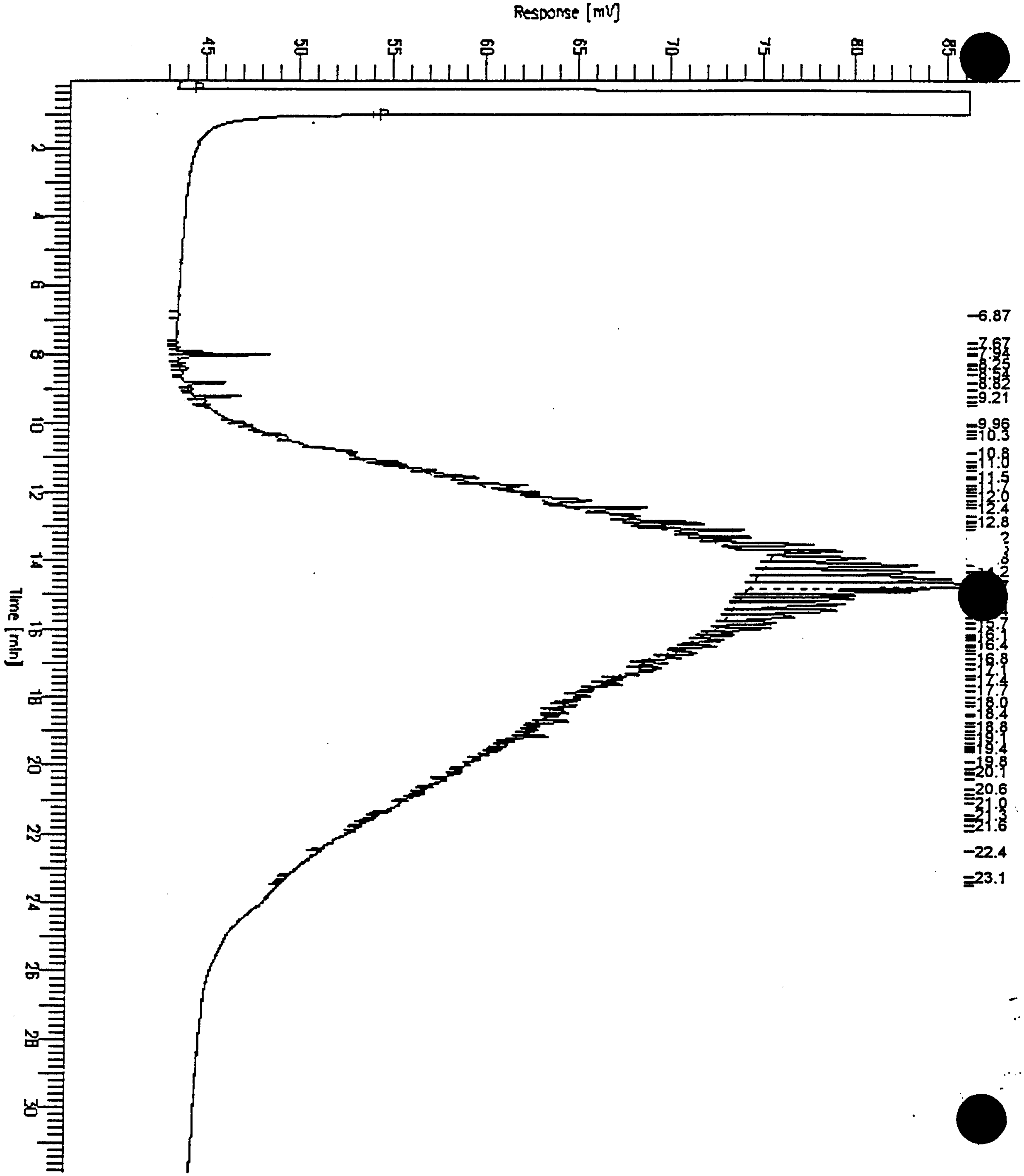


Sample Name : mO 95WS1596 500 mg/L
FileName : C:\GC15\CHB\067B008.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0
End Time : 31.91 min
Plot Offset: 42 mV

Sample #:
Date : 3/8/96 02:01 PM
Time of Injection: 3/7/96 08:23 PM
Low Point : 42.50 mV
Plot Scale: 43.7 mV



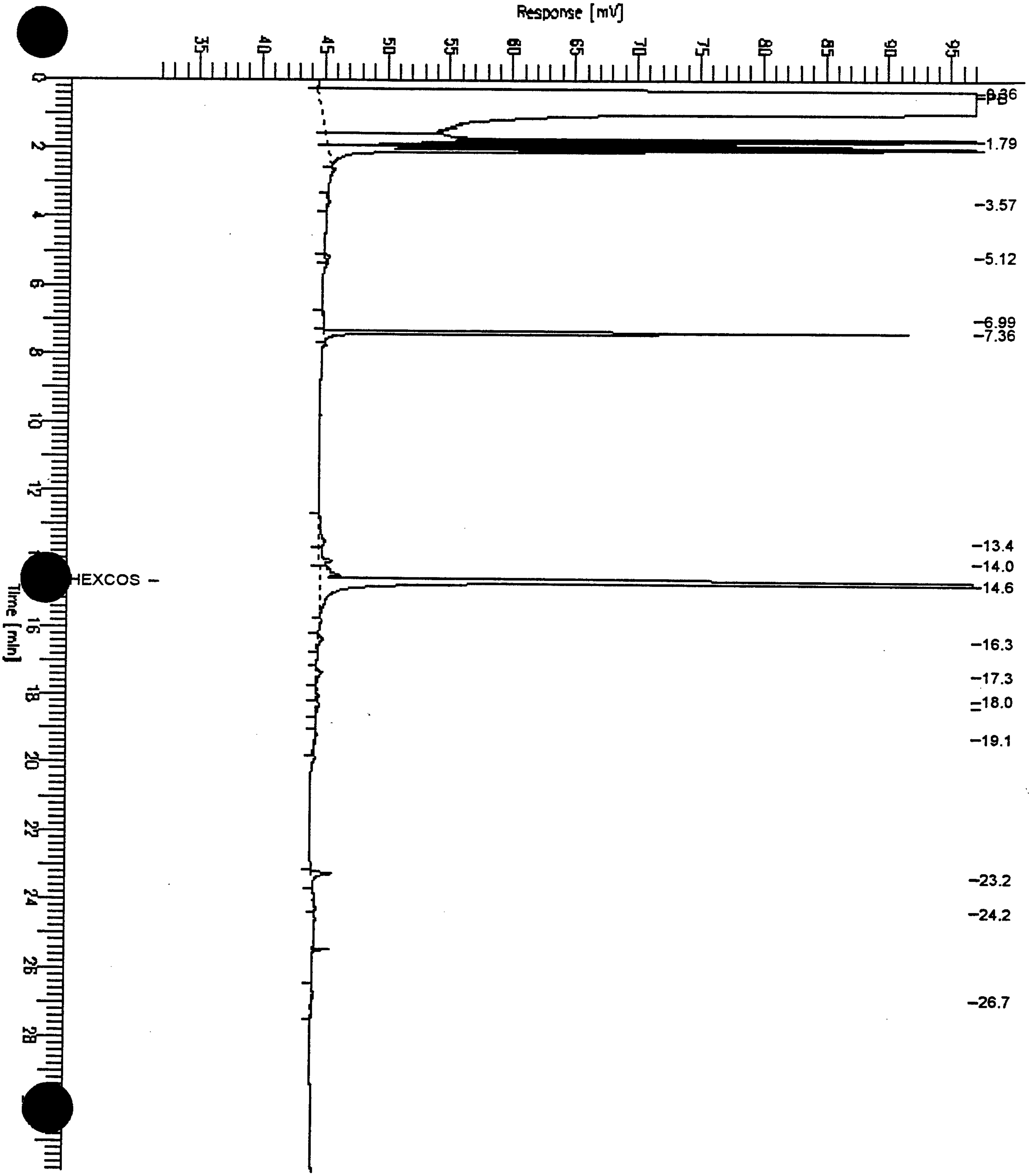
High Point : 86.16 mV



# GC15 Channel A Surrogate

Sample Name : S,124634-004,26268
FileName : C:\GC15\CHB\068B008.raw
Method : DUAL
Start Time : 0.00 min    End Time : 31.90 min
e Factor: 0.0    Plot Offset: 32 mV

Sample #: 26268    Page 1 of 1
Date : 3/8/96 10:42 PM
Time of Injection: 3/8/96 10:09 PM
Low Point : 32.00 mV    High Point : 97.00 mV
Plot Scale: 65.0 mV

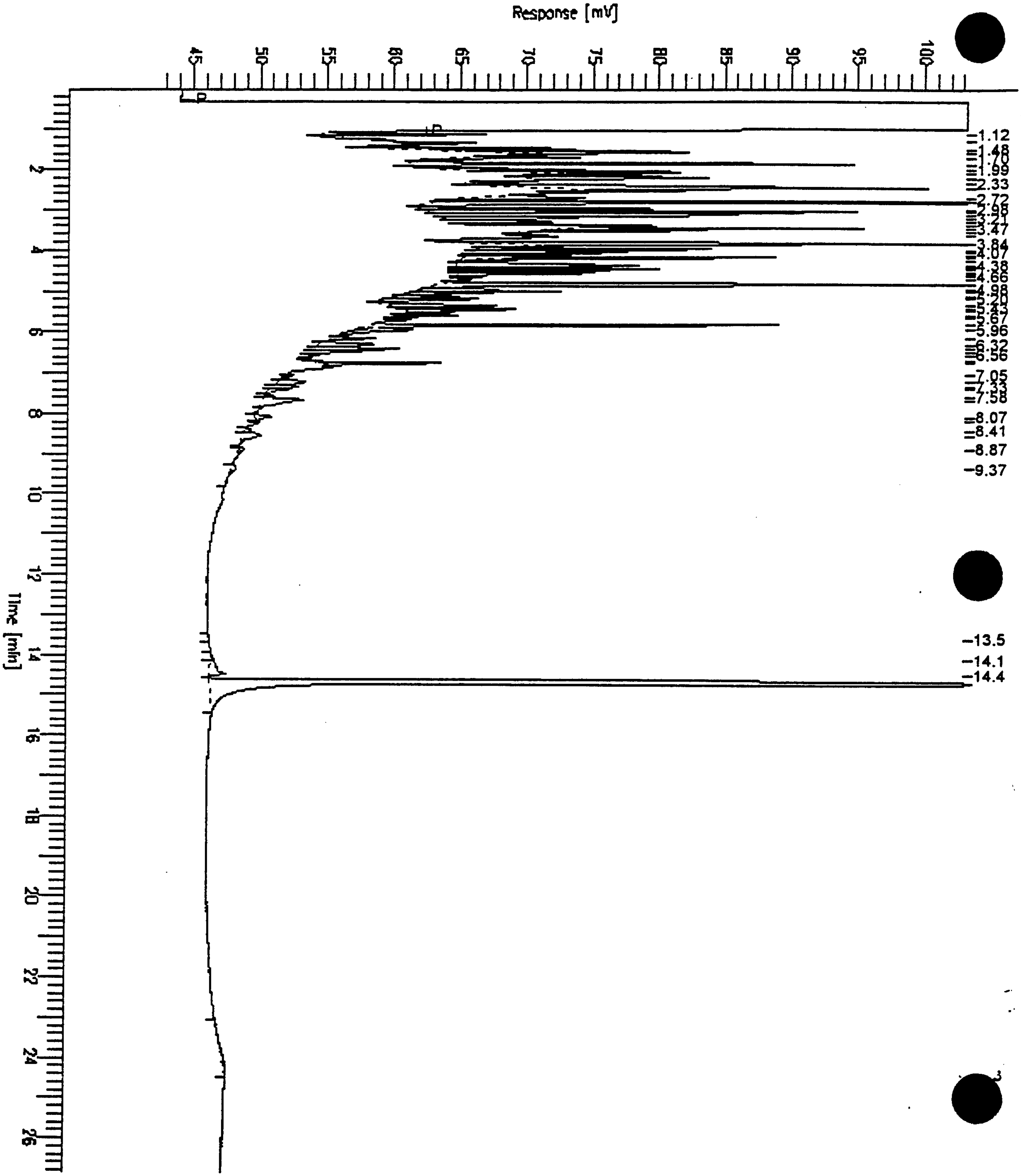


JP 5

# GC15 Channel A TEH

Sample Name : CCV,JP5
FileName : C:\GC15\CHB\067B023.RAW
Method : BTEH.MTH
Start Time : 0.01 min    End Time : 26.87 min
Scale Factor: 0.0    Plot Offset: 42 mV

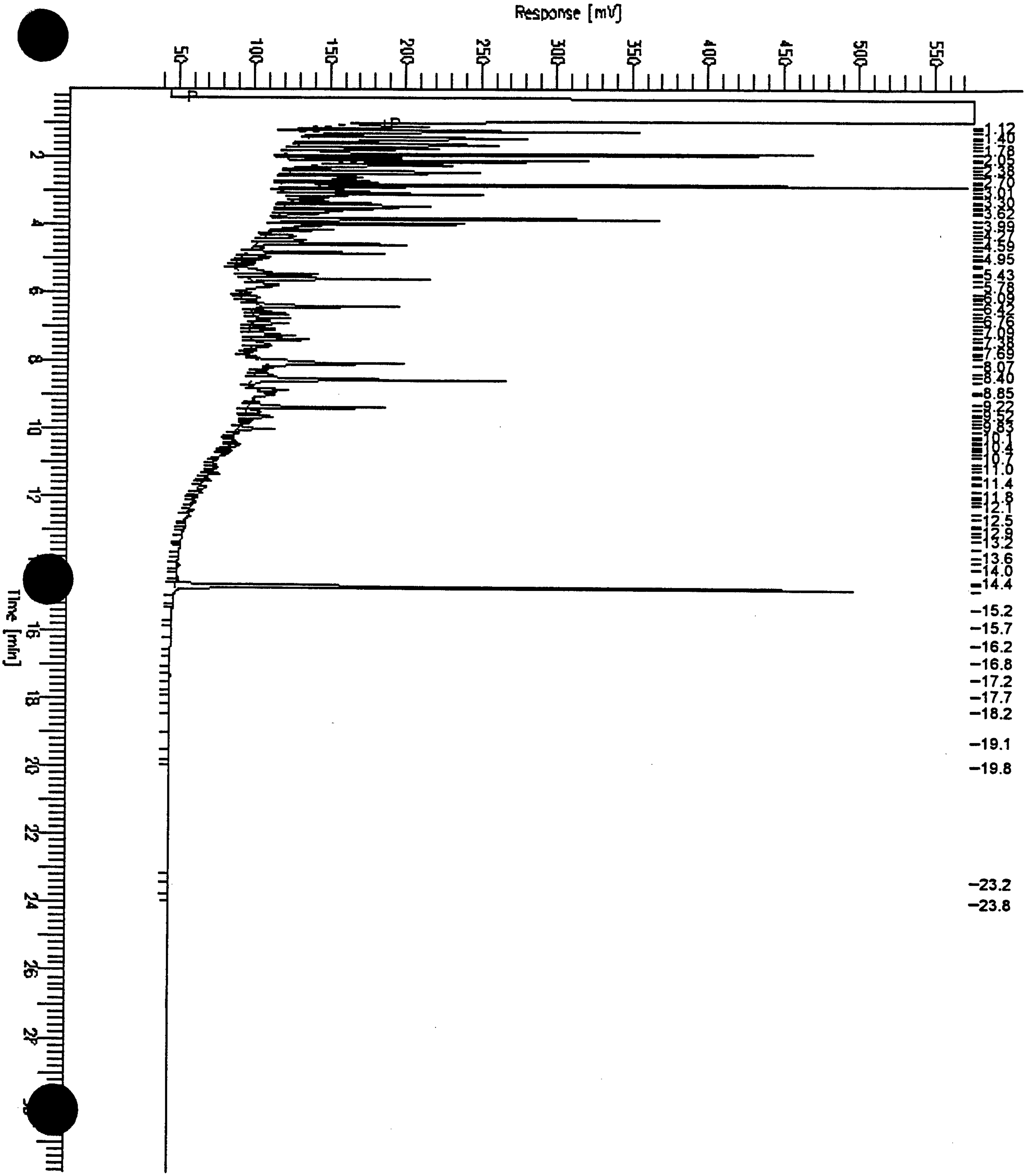
Sample #: 250MG/L    
Date : 3/8/96 01:50 PM
Time of Injection: 3/8/96 07:20 AM
Low Point : 42.42 mV    High Point : 103.22 mV
Plot Scale: 60.8 mV



# GC15 Channel A TEH

Sample Name : S,124634-002,26268
FileName : C:\GC15\CHB\068B007.RAW
Method : BTEH.MTH
Start Time : 0.01 min End Time : 31.91 min
Factor: 0.0 Plot Offset: 38 mV

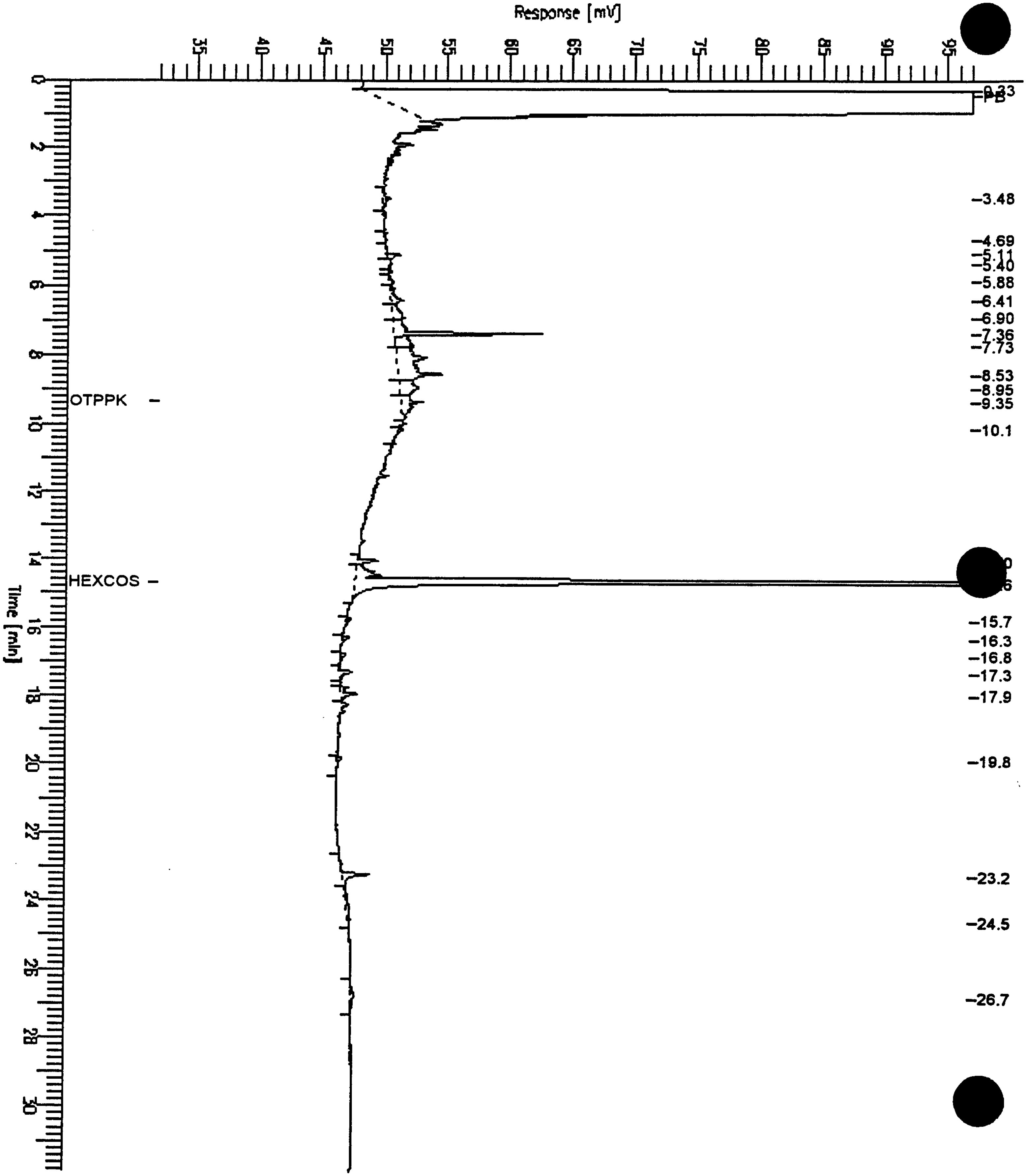
Sample #: 26268 Page 1 of 1
Date : 3/11/96 02:54 PM
Time of Injection: 3/8/96 09:26 PM
Low Point : 37.87 mV High Point : 576.33 mV
Plot Scale: 538.5 mV



# GC15 Channel A Surrogate

Sample Name : S,124634-003,26268
FileName : C:\GC15\CHB\068B006.raw
Method : DUAL
Start Time : 0.00 min    End Time : 31.90 min
Scale Factor: 0.0    Plot Offset: 32 mV

Sample #: 26268    Page 1 of 1
Date : 3/8/96 09:14 PM
Time of Injection: 3/8/96 08:42 PM
Low Point : 32.00 mV    High Point : 97.00 mV
Plot Scale: 65.0 mV



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Lab #: 124634

# BATCH QC REPORT



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: LUFT

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124641-004
Matrix: Soil
Batch#: 26268
Units: mg/Kg dry weight
Diln Fac: 1

Sample Date: 02/27/96
Received Date: 03/01/96
Prep Date: 03/05/96
Analysis Date: 03/08/96
Moisture: 35%

MS Lab ID: QC16521

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Diesel Range | 76.15 | <1.538 | 71.69 | 94 | 60-140 |
| Surrogate | %Rec | Limits | | | |
| Hexacosane | 82 | 60-140 | | | |

MSD Lab ID: QC16522

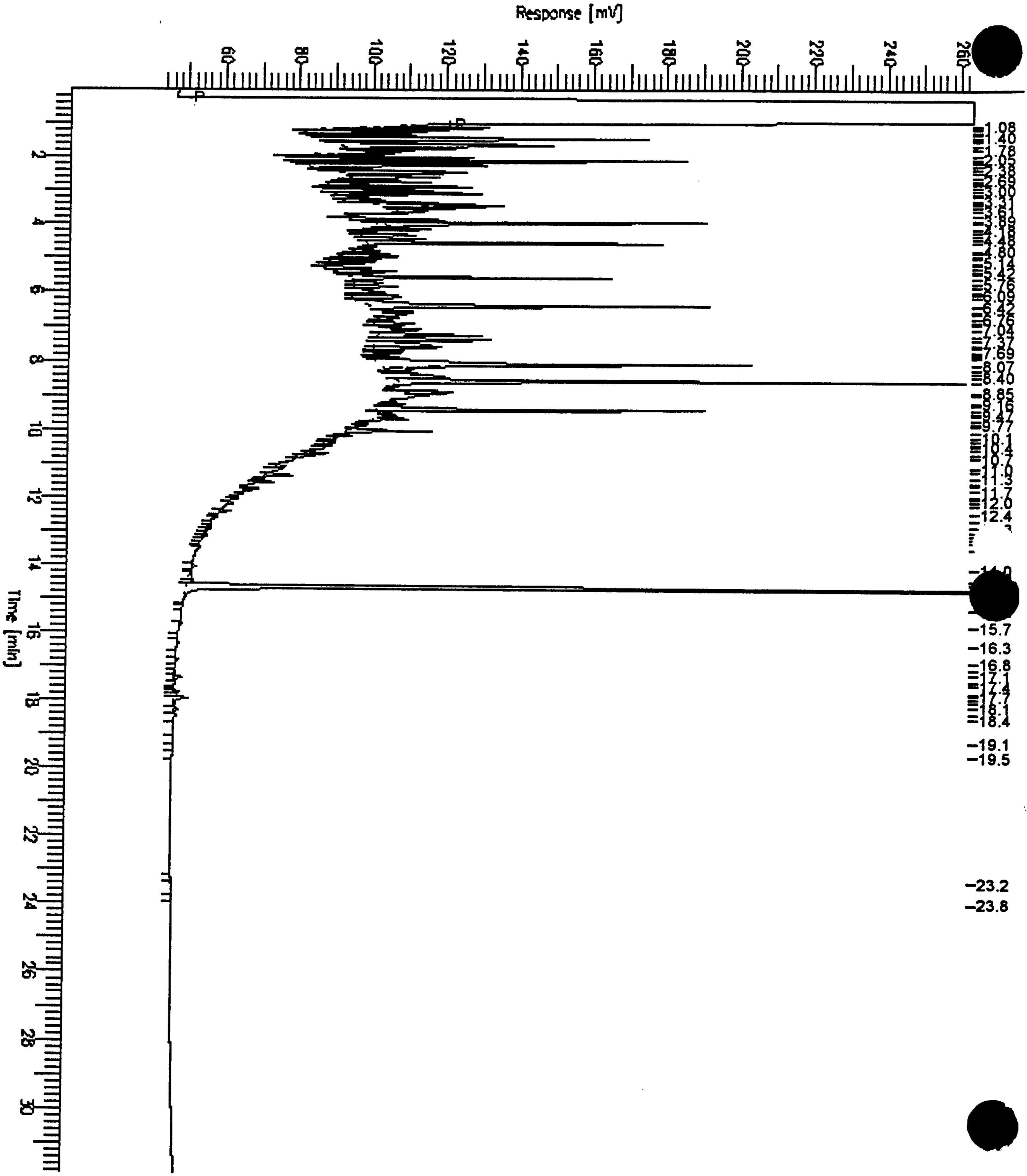
| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Diesel Range | 76.15 | 63.54 | 83 | 60-140 | 12 | <30 |
| Surrogate | %Rec | Limits | | | | |
| Hexacosane | 74 | 60-140 | | | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

GC15 Channel A TEH

Sample Name : S,124634-001,26268
FileName : C:\GC15\CHB\068B014.RAW
Method : BTEH.MTH
Start Time : 0.01 min End Time : 31.91 min
Scale Factor: 0.0 Plot Offset: 42 mV

Sample #: 26268 Page 1 of 1
Date : 3/11/96 02:53 PM
Time of Injection: 3/9/96 02:32 AM
Low Point : 42.46 mV High Point : 263.26 mV
Plot Scale: 220.8 mV



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| TEH-Tot Ext Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: CA LUFT (EPA 8015M)<br>Prep Method: LUFT |

| METHOD BLANK | |
|---|---|
| Matrix: Soil<br>Batch#: 26268<br>Units: mg/Kg<br>Diln Fac: 1 | Prep Date: 03/05/96<br>Analysis Date: 03/08/96 |

MB Lab ID: QC16519

| Analyte | Result | |
|---|---|---|
| JP5 | <1.0 | |
| Diesel Range | <1.0 | |
| Motor Oil Range | <5.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 69 | 60-140 |

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TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: LUFT

LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26268
Units: mg/Kg
Diln Fac: 1

Prep Date: 03/05/96
Analysis Date: 03/08/96

LCS Lab ID: QC16520

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Diesel Range | 40.1 | 49.5 | 81 | 60-140 |
| Surrogate | %Rec | Limits | | |
| Hexacosane | 69 | 60-140 | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd

Laboratory Number: 124634
Client: Parsons Engineering Science Inc.
Project#: 722450.14020
Location: Beale AFB

Date Sampled: 02/28/96
Date Received: 02/29/96
Date Analyzed: 03/12/96
Batch: 26372

Analysis: Total Organic Carbon
Analysis Method: EPA 9060

| LAB ID | SAMPLE ID | RESULT | UNITS | REPORTING LIMIT |
|---|---|---|---|---|
| 124634-004 | BE-MP19-7.0 | 90 | mg/Kg | 50 |
| 124634-Method | Blank | ND | mg/Kg | 50 |

ND = Not detected at or above reporting limit.

QA/QC SUMMARY:

| | | |
|---|---|---|
| MS/MSD RPD, % | <1 | (Limit: < 30 ) |
| MS/MSD AVG Recovery,% | 87 | (Limits: 50-150) |
| LCS Recovery,% | 94 | (Limits: 65-135) |

QC Sample: 124634-004

Curtis & Tompkins, Ltd



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: LUFT

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124634-001 | BE-MP15-9.5 | 26268 | 02/27/96 | 03/05/96 | 03/09/96 | 10% |
| 124634-002 | BE-MP10-5.5 | 26268 | 02/28/96 | 03/05/96 | 03/08/96 | 10% |
| 124634-003 | BE-MP11-7.0 | 26268 | 02/28/96 | 03/05/96 | 03/08/96 | 12% |
| 124634-004 | BE-MP19-7.0 | 26268 | 02/28/96 | 03/05/96 | 03/08/96 | 9% |

| Analyte<br>Diln Fac: | Units | 124634-001<br>1 | 124634-002<br>1 | 124634-003<br>1 | 124634-004<br>1 |
|---|---|---|---|---|---|
| JP5 | mg/Kg | 73 Y | 110 Y | 5.5YH | 1.3Z |
| Diesel Range | mg/Kg | 110 Y | 120 Y | 10 Y | 1.3Z |
| Motor Oil Range | mg/Kg | <5.6 | <5.6 | <5.7 | <5.5 |
| **Surrogate** | | | | | |
| Hexacosane | %REC | 92 | 92 | 100 | 94 |

Y: Sample exhibits fuel pattern which does not resemble standard
Z: Sample exhibits unknown single peak or peaks
H: Heavier hydrocarbons than indicated standard

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# A N A L Y T I C A L   R E P O R T

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 18-MAR-96
Lab Job Number: 124634
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Teresa K Morrison

Reviewed by: 

**Laboratory Number: 124634**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 02/27,28/96**
**Receipt Date:02/29/96**

## CASE NARRATIVE

Curtis & Tompkins Ltd. received four soil samples from the above referenced project on Feb.29,1996. All samples were received cold and intact. Chromatograms are included in this report for any samples containing quantifiable concentrations of extractable or purgeable hydrocarbons, along with example chromatograms for each type of fuel.

**TOC (EPA 9060)**: No analytical problems were encountered.

**TPH/Extractable**: The "Z" qualifier flag appears for sample BE-MP19-7.0 (C&T# 124634-004) indicating that the chromatogram does not resemble a fuel pattern, but consists of individual, strongly differentiated peaks.

**TPH/Purgeable**: The chromatograms for these samples do not resemble gasoline, but are similar to a JP-4 standard which is occasionally requested. A JP-4 chromatogram is also included in this report for comparison purposes.

**BTXE + TMBs (EPA 8020)**: Trifluorotoluene failed surrogate recovery limits for sample BE-MP10-5.5 (C&T# 124634-002) due to coelution of sample hydrocarbons with the surrogate. The "C" qualifier flag indicates that the target compound reported was confirmed by a second analytical column, but that the concentration quantitated on the second column differed from the reported concentration by more than a factor of two. This often happens when the fuel pattern present in the samples does not resemble gasoline, as is the case with this sample set. Ethylbenzene and xylene matrix spike and spike duplicate recoveries failed QC limits due to high levels of non-target hydrocarbons present in the spiked sample. The sample spiked was not from Beale AFB and the associated laboratory control sample passed all acceptance criteria.

**PARSONS ENGINEERING SCIENCE, INC.**
1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

124633

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020

Project Name/Location: Beale AFB, UST Site

Project Manager: Todd Wiedemeier (Denver, CO)

Site Manager: Michael Phelps (Alameda, CA)

Sampler(s): (Initials and Signature(s))
Todd Michael Bley

Note: All analyses and holding times according to AFCEE handbook requirements.

| | Sample ID | Date | Time | Begin Depth | End Depth | Matrix | NO. OF CONTAINERS | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see notes 1, 2 | Leachable TPH (DI-WET/8015m) notes 1,2,3 | BTEX and TMBs (5030/8020) see notes 1,4 | Halogenated VOCs (5030/8010) see note 1 | SVOCs (3550/8270) | TOC (9060) | TKN (E351.2) | Alkalinity (Std Meth 403) | Total Phosphorus (E365.3) | Total Iron (6010 trace) | pH (9045) | Moisture Content (ASTM D-2216) | Grain-size (ASTM D-422) | OTHER | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BE-MP09-6 | 2/27/96 | 0840 | 6.0 | 6.5 | soil | 1 | X | X | | X | | | | | | | | | | | | | TMBs; note 4 |
| 2 | BE-MP12-4 | 2/27/96 | 1055 | 4.0 | 4.5 | soil | 1 | X | X | | X | | | | | | | | | | | | | " ; " |
| 3 | BE-MP13-6.5 | 2/27/96 | 1230 | 6.5 | 7.0 | soil | 1 | X | X | | X | | | | | | | | | | | | | " ; " |
| 4 | BE-MP14-7 | 2/27/96 | 1315 | 7.0 | 7.5 | soil | 1 | X | X | | X | | | | | | | | | | | | | " ; " |
| 5 | BE-MP22-7 | 2/27/96 | 1510 | 7.0 | 7.5 | soil | 1 | X | X | | X | | | | | | | | | | | | | " ; " |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | Level III |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | 3.75 |
| | | | | | | soil | | | | | | | | | | | | | | | | | | TEMP RECEIVED: |
| | | | | | | soil | | | | | | | | | | | | | | | | | | RECEIVED BY: |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| Mike Bley | 2/27/96 | 1600 | |
| **RELINQUISHED BY: (SIGNATURE)** | **DATE** | **TIME** | **RECEIVED FOR LAB BY: (SIGNATURE)** |
| | | | Jason Quelle 2/28/96 |

NOTES:
1. Secondary column confirmation required.
2. Quantify all carbon ranges: diesel, jet fuel, oil/grease.
3. Deionized water extraction
4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

| DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|
| | | FAX COC on check in to Site Manager. |

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples

Beale

Curtis & Tompkins, Ltd.

# COOLER RECEIPT CHECKLIST

Login#: 124633 Date Received: 2/28 Number of Coolers: 1

Client: Parsons Eng. Science Project: 722450.14020 Beale

A. Preliminary Examination Phase

Date Opened: 2/28 By (print): J. Wallins (sign) Jason Q. Wallins

1. Did cooler come with a shipping slip (airbill, etc.)? ........ YES NO

If YES, enter carrier name and airbill number: Fed Ex 1154092483

2. Were custody seals on outside of cooler? ........ YES NO

How many and where? ______ Seal date: ______ Seal name: ______

3. Were custody seals unbroken and intact at the date and time of arrival? ........ YES NO N/A

4. Were custody papers dry and intact when received? ........ YES NO

5. Were custody papers filled out properly (ink, signed, etc.)? ........ YES NO

6. Did you sign the custody papers in the appropriate place? ........ YES NO

7. Was project identifiable from custody papers? ........ YES NO

If YES, enter project name at the top of this form.

8. If required, was sufficient ice used? ........ YES NO

Type of ice: cube/blue Temperature: 3.75°C

B. Login Phase

Date Logged In: 2/29 By (print): J. Wallins (sign) Jason Q. Wallins

1. Describe type of packing in cooler: ______

2. Did all bottles arrive unbroken? ........ YES NO

3. Were labels in good condition and complete (ID, date, time, signature, etc.)? ........ YES NO

4. Did bottle labels agree with custody papers? ........ YES NO

5. Were appropriate containers used for the tests indicated? ........ YES NO

6. Were correct preservatives added to samples? ........ YES NO

7. Was sufficient amount of sample sent for tests indicated? ........ YES NO

8. Were bubbles absent in VOA samples? If NO, list sample Ids below ........ YES NO N/A

9. Was the client contacted concerning this sample delivery? ........ YES NO

If YES, give details below.

Who was called? ______ By whom? ______ Date: ______

Additional Comments:

Lab #: 124633

# BATCH QC REPORT



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26389
Units: ug/Kg
Diln Fac: 1

Prep Date: 03/13/96
Analysis Date: 03/13/96

LCS Lab ID: QC16982

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 98 | 100 | 98 | 80-120 |
| Toluene | 100 | 100 | 100 | 80-120 |
| Ethylbenzene | 95 | 100 | 95 | 80-120 |
| m,p-Xylenes | 191 | 200 | 96 | 80-120 |
| o-Xylene | 102 | 100 | 102 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 87 | 43-114 |
| Bromobenzene | 74 | 45-140 |

Column to be used to flag recovery and RPD values with an asterisk
alues outside of QC limits
ke Recovery: 0 out of 5 outside limits

## BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

| | |
|---|---|
| Field ID: ZZZZZZ | Sample Date: 02/26/96 |
| Lab ID: 124736-001 | Received Date: 02/29/96 |
| Matrix: Soil | Prep Date: 03/11/96 |
| Batch#: 26345 | Analysis Date: 03/11/96 |
| Units: ug/Kg dry weight | Moisture: 8% |
| Diln Fac: 1 | |

MS Lab ID: QC16894

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Benzene | 108.7 | <5.435 | 109.8 | 101 | 75-125 |
| Toluene | 108.7 | <5.435 | 105.4 | 97 | 75-125 |
| Ethylbenzene | 108.7 | <5.435 | 83.7 | 77 | 75-125 |
| m,p-Xylenes | 217.4 | <5.435 | 157.6 | 72 * | 75-125 |
| o-Xylene | 108.7 | <5.435 | 115.2 | 106 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 93 | 43-114 |
| Bromobenzene | 69 | 45-140 |

MSD Lab ID: QC16895

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Benzene | 108.7 | 98.91 | 91 | 75-125 | 10 | <20 |
| Toluene | 108.7 | 90.22 | 83 | 75-125 | 16 | <20 |
| Ethylbenzene | 108.7 | 71.74 | 66 * | 75-125 | 15 | <20 |
| m,p-Xylenes | 217.4 | 132.6 | 61 * | 75-125 | 17 | <20 |
| o-Xylene | 108.7 | 108.7 | 100 | 75-125 | 6 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 93 | 43-114 |
| Bromobenzene | 70 | 45-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 5 outside limits
Spike Recovery: 3 out of 10 outside limits

Curtis & Tompkins, Ltd



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## METHOD BLANK

Matrix: Soil
Batch#: 26389
Units: ug/Kg
Diln Fac: 1

Prep Date: 03/12/96
Analysis Date: 03/12/96

MB Lab ID: QC16980

| Analyte | Result |
|---|---|
| Benzene | <5.0 |
| Toluene | <5.0 |
| Ethylbenzene | <5.0 |
| m,p-Xylenes | <5.0 |
| o-Xylene | <5.0 |
| 1,2,3-Trimethylbenzene | <5.0 |
| 1,2,4-Trimethylbenzene | <5.0 |
| 1,3,5-Trimethylbenzene | <5.0 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| rifluorotoluene | 94 | 43-114 |
| romobenzene | 82 | 45-140 |

Curtis & Tompkins, Ltd.



**BTXE**

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

**LABORATORY CONTROL SAMPLE**

Matrix: Soil
Batch#: 26345
Units: ug/Kg
Diln Fac: 1

Prep Date: 03/11/96
Analysis Date: 03/11/96

LCS Lab ID: QC16893

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 106 | 100 | 106 | 80-120 |
| Toluene | 109 | 100 | 109 | 80-120 |
| Ethylbenzene | 105 | 100 | 105 | 80-120 |
| m,p-Xylenes | 214 | 200 | 107 | 80-120 |
| o-Xylene | 109 | 100 | 109 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 89 | 43-114 |
| Bromobenzene | 74 | 45-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd.



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124633-005 | BE-MP22-7 | 26389 | 02/27/96 | 03/12/96 | 03/12/96 | 20% |

| Analyte | Units | 124633-005 | |
|---|---|---|---|
| Diln Fac: | | 25 | |
| Benzene | ug/Kg | <16 | |
| Toluene | ug/Kg | <16 | |
| Ethylbenzene | ug/Kg | <16 | |
| m,p-Xylenes | ug/Kg | 150 | C |
| o-Xylene | ug/Kg | <16 | |
| 1,2,3-Trimethylbenzene | ug/Kg | 78 | |
| 1,2,4-Trimethylbenzene | ug/Kg | 70 | C |
| 1,3,5-Trimethylbenzene | ug/Kg | 36 | |
| **Surrogate** | | | |
| Trifluorotoluene | %REC | 94 | |
| Bromobenzene | %REC | 78 | |

C: Presence of this compound confirmed by second column, however, the confirmation concentration differed from the reported result by more than a factor of two

Curtis & Tompkins, Ltd.

Lab #: 124633

# BATCH QC REPORT



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## METHOD BLANK

Matrix: Soil
Batch#: 26345
Units: ug/Kg
Diln Fac: 1

Prep Date: 03/11/96
Analysis Date: 03/11/96

MB Lab ID: QC16891

| Analyte | Result |
|---|---|
| Benzene | <5.0 |
| Toluene | <5.0 |
| Ethylbenzene | <5.0 |
| m,p-Xylenes | <5.0 |
| o-Xylene | <5.0 |
| 1,2,3-Trimethylbenzene | <5.0 |
| 1,2,4-Trimethylbenzene | <5.0 |
| 1,3,5-Trimethylbenzene | <5.0 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| Trifluorotoluene | 87 | 43-114 |
| Bromobenzene | 71 | 45-140 |

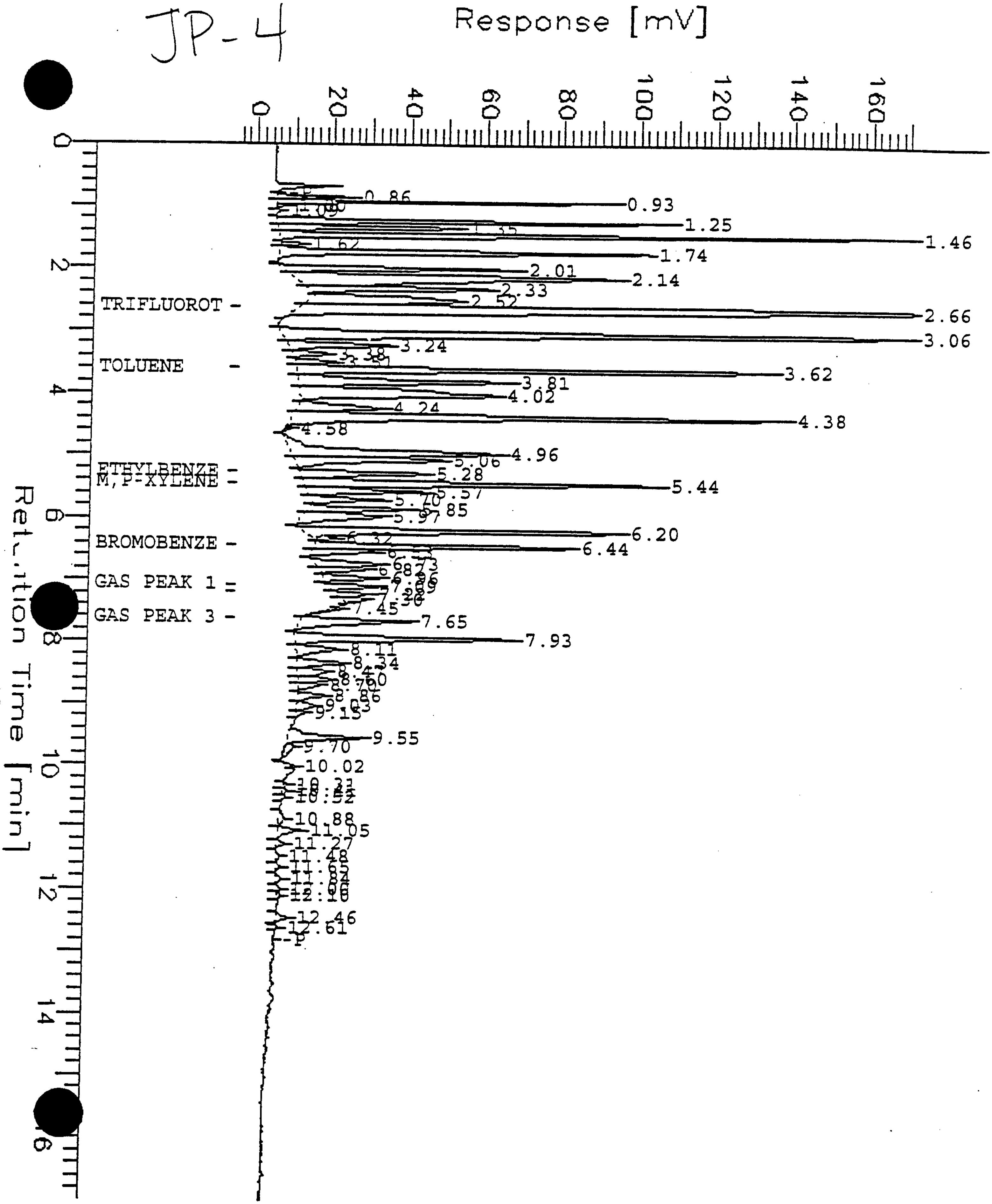
FileName : G:\GC04\B\026J011.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 17.00 min
Plot Offset: -4 mV

Date : 2/1/95 3:57 PM
Low Point : -4.15 mV
Plot Scale: 175 mV



High Point : 170.85 mV



# BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124633-001 | BE-MP09-6 | 26345 | 02/27/96 | 03/12/96 | 03/12/96 | 14% |
| 124633-002 | BE-MP12-4 | 26345 | 02/27/96 | 03/12/96 | 03/12/96 | 16% |
| 124633-003 | BE-MP13-6.5 | 26345 | 02/27/96 | 03/12/96 | 03/12/96 | 14% |
| 124633-004 | BE-MP14-7 | 26345 | 02/27/96 | 03/12/96 | 03/12/96 | 15% |

| Analyte | Units | 124633-001 | 124633-002 | 124633-003 | 124633-004 |
|---|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | 1 | 1 |
| Benzene | ug/Kg | <5.8 | <6 | <5.8 | <5.9 |
| Toluene | ug/Kg | <5.8 | <6 | <5.8 | <5.9 |
| Ethylbenzene | ug/Kg | <5.8 | <6 | <5.8 | <5.9 |
| m,p-Xylenes | ug/Kg | <5.8 | <6 | <5.8 | 81 C |
| o-Xylene | ug/Kg | <5.8 | <6 | <5.8 | <5.9 |
| 1,2,3-Trimethylbenzene | ug/Kg | <5.8 | <6 | <5.8 | 120 |
| 1,2,4-Trimethylbenzene | ug/Kg | <5.8 | <6 | <5.8 | 160 |
| 1,3,5-Trimethylbenzene | ug/Kg | <5.8 | <6 | <5.8 | 130 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 86 | 88 | 64 | 133 * |
| Bromobenzene | %REC | 75 | 76 | 53 | 76 |

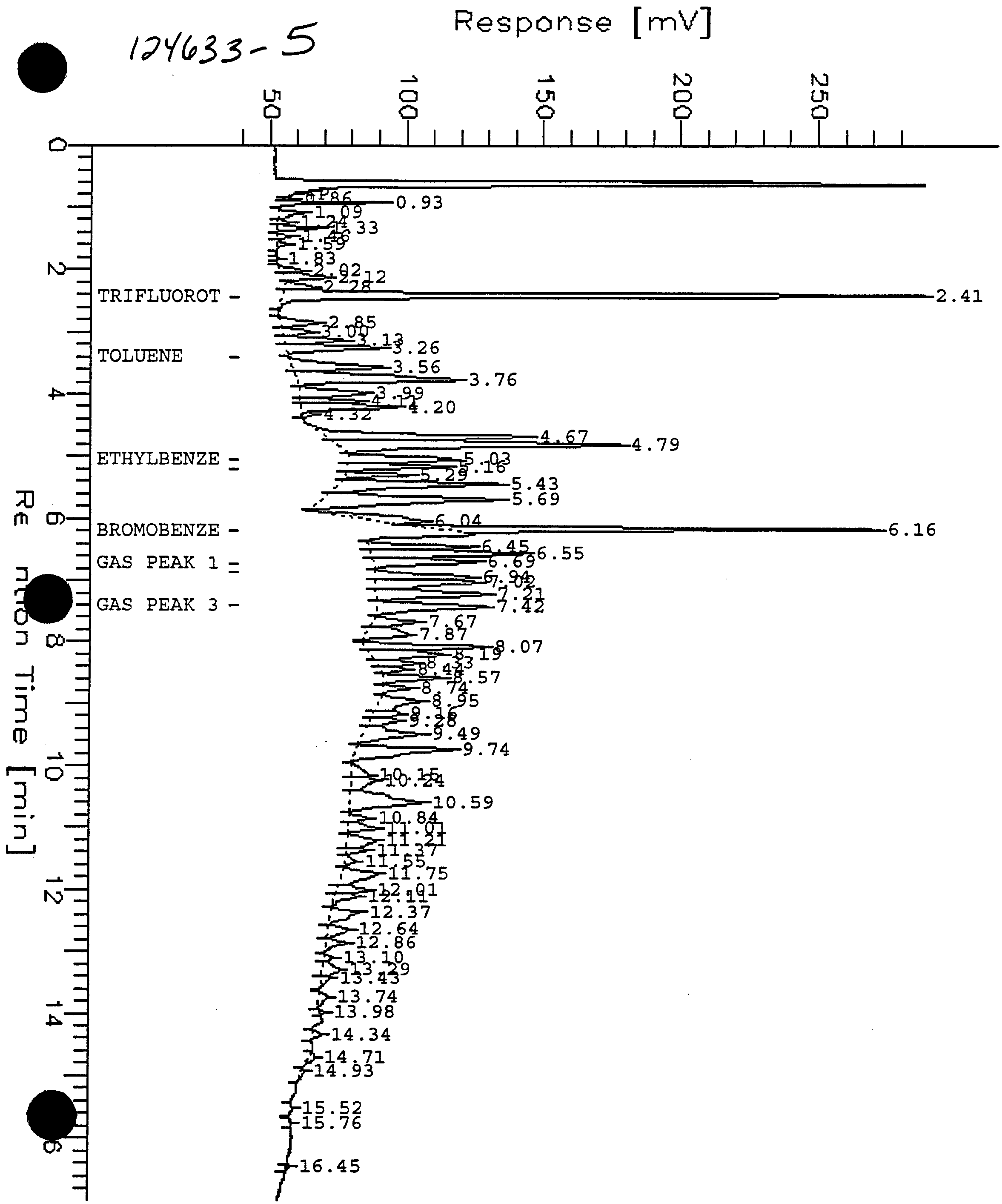
* Values outside of QC limits

C: Presence of this compound confirmed by second column, however, the confirmation concentration differed from the reported result by more than a factor of two

TVH2 - GC-04 RTX-1

FileName : G:\GC04\072J006.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 17.00 min
Plot Offset: 39 mV
Date : 3/12/96 4:56 PM
Low Point : 38.90 mV
Plot Scale: 250 mV
Page 1 of 1
High Point : 288.90 mV

124633-5



C+T Gasoline Std.

TVH2 - GC-04 RTX-1

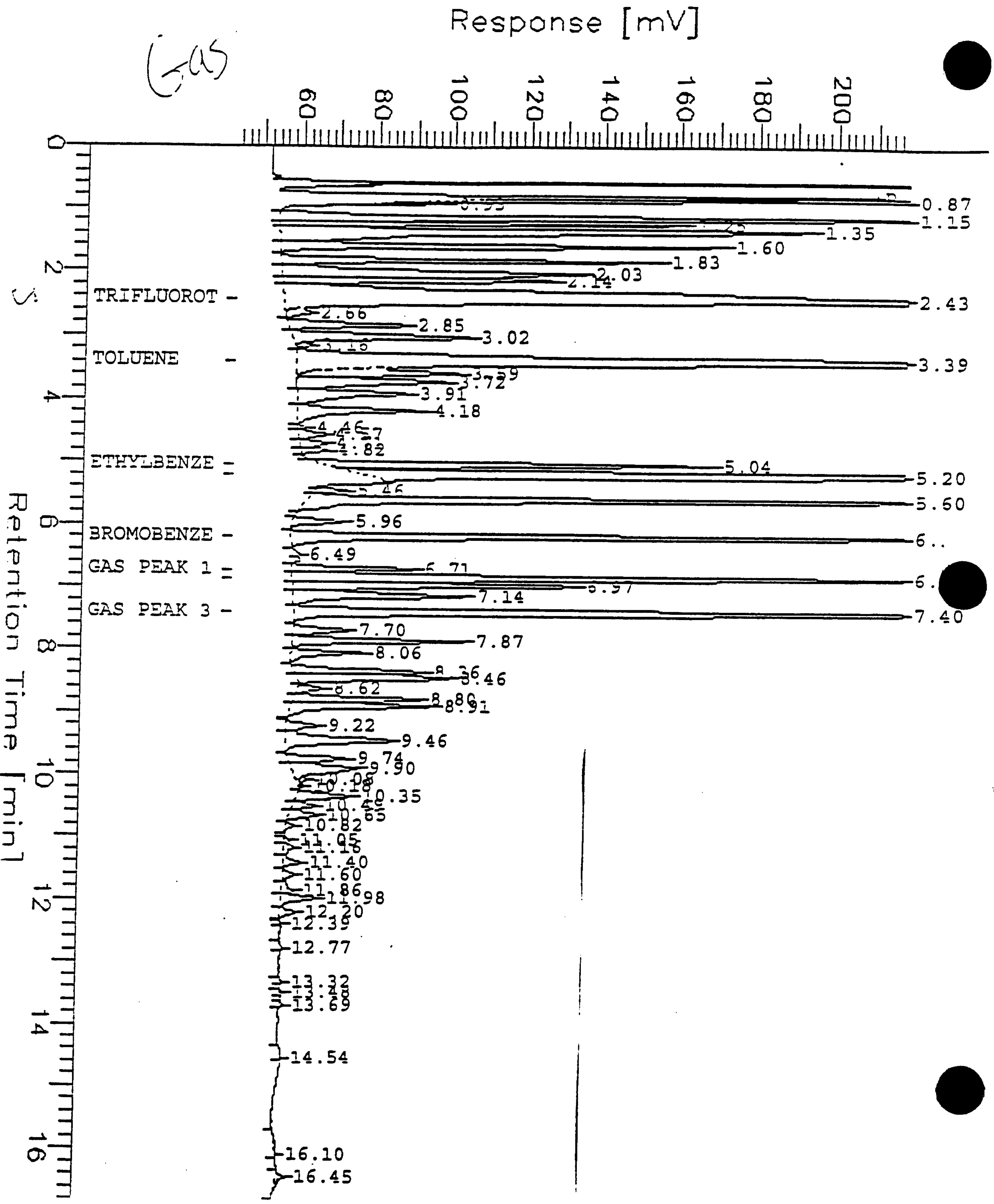
FileName : G:\GC04\135J001.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 17.00 min
Plot Offset: 43 mV

Date : 5/15/95 9:53 AM
Low Point : 42.92 mV
Plot Scale: 175 mV

Page 1 of 1
High Point : 217.92 mV

Gas



Curtis & Tompkins, Ltd.



## TVH-Total Volatile Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

| | | | |
|---|---|---|---|
| Field ID: | ZZZZZZ | Sample Date: | 02/29/96 |
| Lab ID: | 124660-002 | Received Date: | 03/04/96 |
| Matrix: | Soil | Prep Date: | 03/13/96 |
| Batch#: | 26389 | Analysis Date: | 03/13/96 |
| Units: | mg/Kg | | |
| Diln Fac: | 1 | | |

MS Lab ID: QC16983

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 10 | <1.000 | 7.7 | 77 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 95 | 52-127 |
| Bromobenzene | 90 | 47-112 |

MSD Lab ID: QC16984

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 10 | 7.8 | 78 | 75-125 | 1 | <20 |

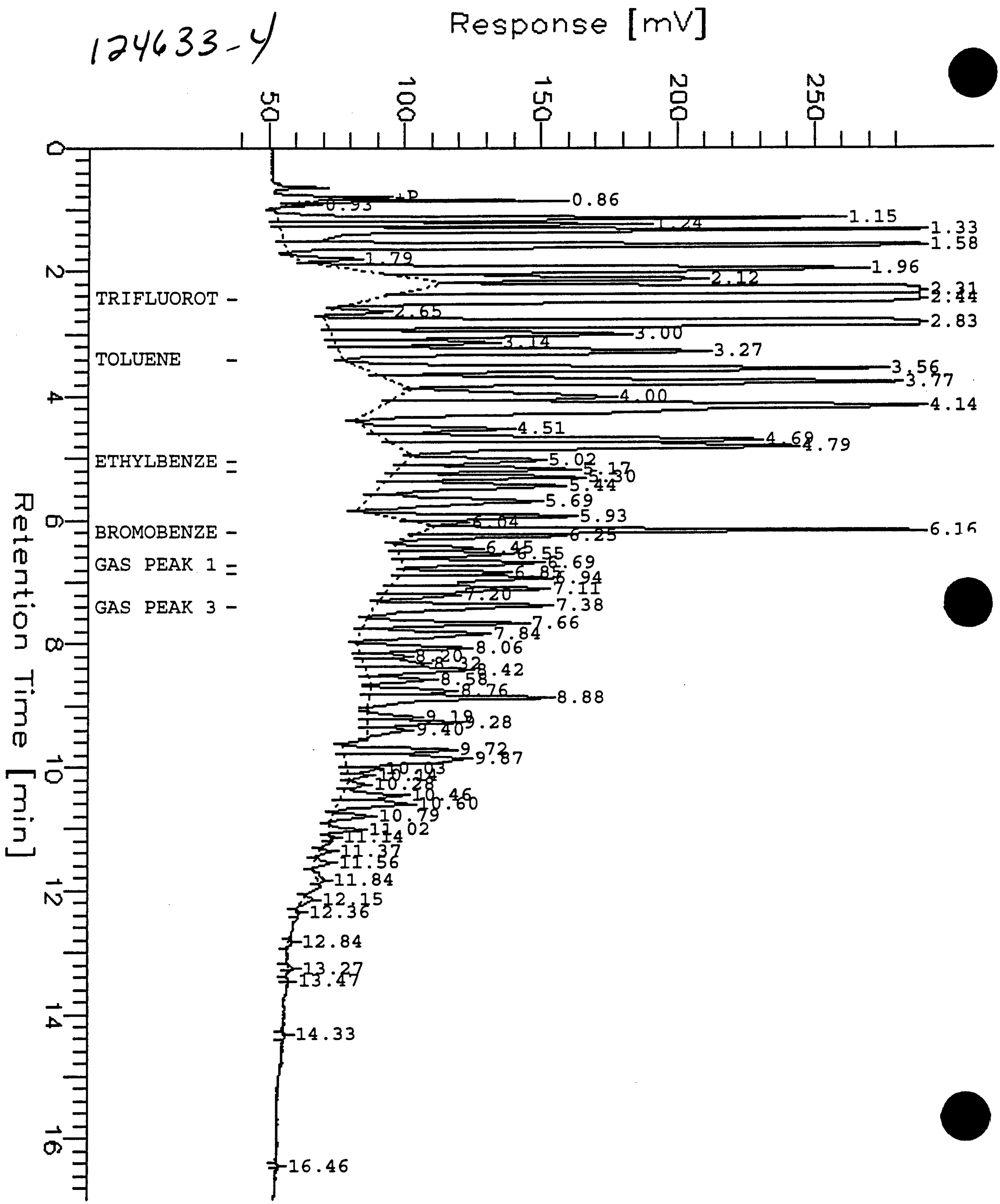
| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 99 | 52-127 |
| Bromobenzene | 91 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

TVH2 - GC-04 RTX-1

FileName : G:\GC04\071J027.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 17.00 min
Plot Offset: 38 mV
Date : 3/12/96 2:25 AM
Low Point : 38.41 mV
Plot Scale: 250 mV
Page 1 of 1
High Point : 288.41 mV

124633-4



Lab #: 124633

BATCH QC REPORT



TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26345
Units: mg/Kg
Diln Fac: 1

Prep Date: 03/11/96
Analysis Date: 03/11/96

LCS Lab ID: QC16892

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 10.1 | 10 | 101 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 106 | 52-127 |
| Bromobenzene | 90 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
`pike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/12/96 |
| Batch#: 26389 | Analysis Date: 03/12/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

LCS Lab ID: QC16981

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 10.2 | 10 | 102 | 80-120 |
| **Surrogate** | **%Rec** | **Limits** | | |
| Trifluorotoluene | 108 | 52-127 | | |
| Bromobenzene | 89 | 47-112 | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd.

Lab #: 124633

BATCH QC REPORT



TVH-Total Volatile Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

METHOD BLANK

| | | | |
|---|---|---|---|
| Matrix: | Soil | Prep Date: | 03/11/96 |
| Batch#: | 26345 | Analysis Date: | 03/11/96 |
| Units: | mg/Kg | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC16891

| Analyte | Result | |
|---|---|---|
| Gasoline | <1.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 93 | 52-127 |
| Bromobenzene | 78 | 47-112 |

Curtis & Tompkins, Ltd



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

### METHOD BLANK

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/12/96 |
| Batch#: 26389 | Analysis Date: 03/12/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

MB Lab ID: QC16980

| Analyte | Result | |
|---|---|---|
| Gasoline | <1.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 96 | 52-127 |
| Bromobenzene | 85 | 47-112 |

Curtis & Tompkins, Ltd.

Lab #: 124634

BATCH QC REPORT



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/12/96 |
| Batch#: 26389 | Analysis Date: 03/12/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

LCS Lab ID: QC16981

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 10.2 | 10 | 102 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 108 | 52-127 |
| Bromobenzene | 89 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd

Lab #: 124634

BATCH QC REPORT



TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

| | |
|---|---|
| Field ID: ZZZZZZ | Sample Date: 02/29/96 |
| Lab ID: 124660-002 | Received Date: 03/04/96 |
| Matrix: Soil | Prep Date: 03/13/96 |
| Batch#: 26389 | Analysis Date: 03/13/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

MS Lab ID: QC16983

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 10 | <1.000 | 7.7 | 77 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 95 | 52-127 |
| Bromobenzene | 90 | 47-112 |

MSD Lab ID: QC16984

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 10 | 7.8 | 78 | 75-125 | 1 | <20 |

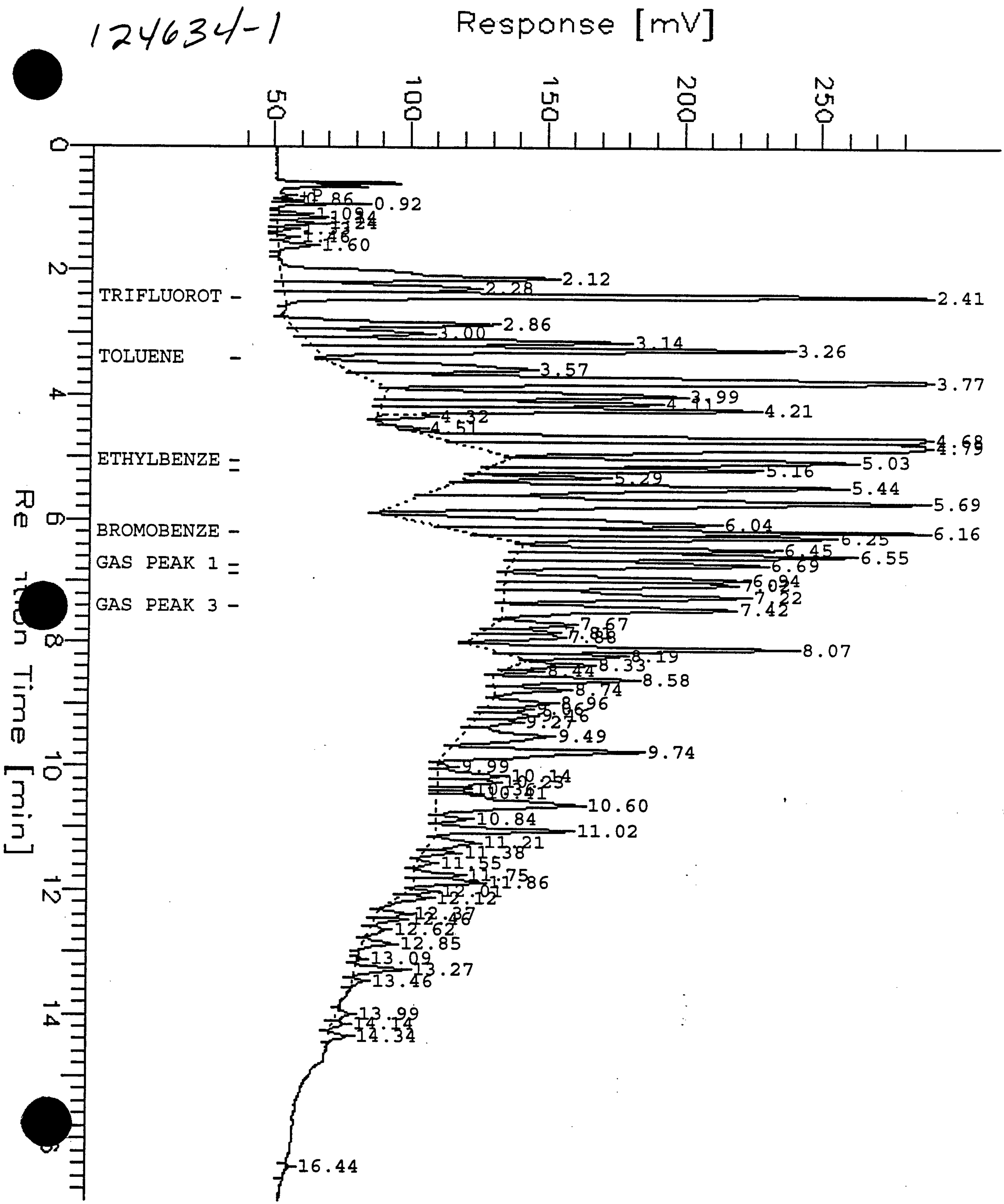
| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 99 | 52-127 |
| Bromobenzene | 91 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

TVH2 - GC-04 RTX-1

FileName : G:\GC04\072J005.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 17.00 min
Plot Offset: 38 mV
Date : 3/12/96 4:18 PM
Low Point : 38.06 mV
Plot Scale: 250 mV
Page 1 of 1
High Point : 288.06 mV

124634-1



TVH2 - GC-04 RTX-1

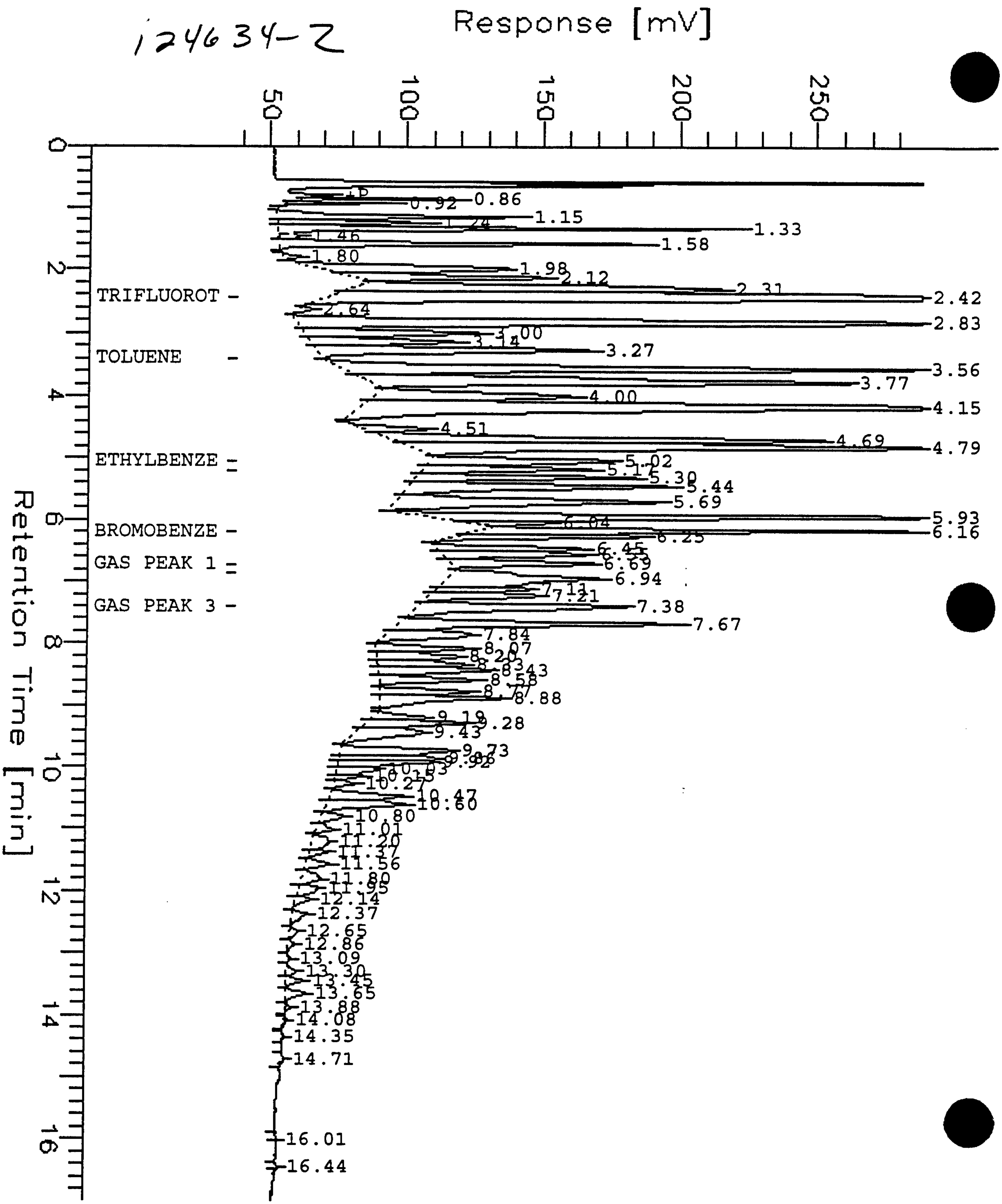
FileName : G:\GC04\072J008.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 17.00 min
Plot Offset: 39 mV

Date : 3/12/96 5:52 PM
Low Point : 38.59 mV
Plot Scale: 250 mV

Page 1 of 1
High Point : 288.59 mV

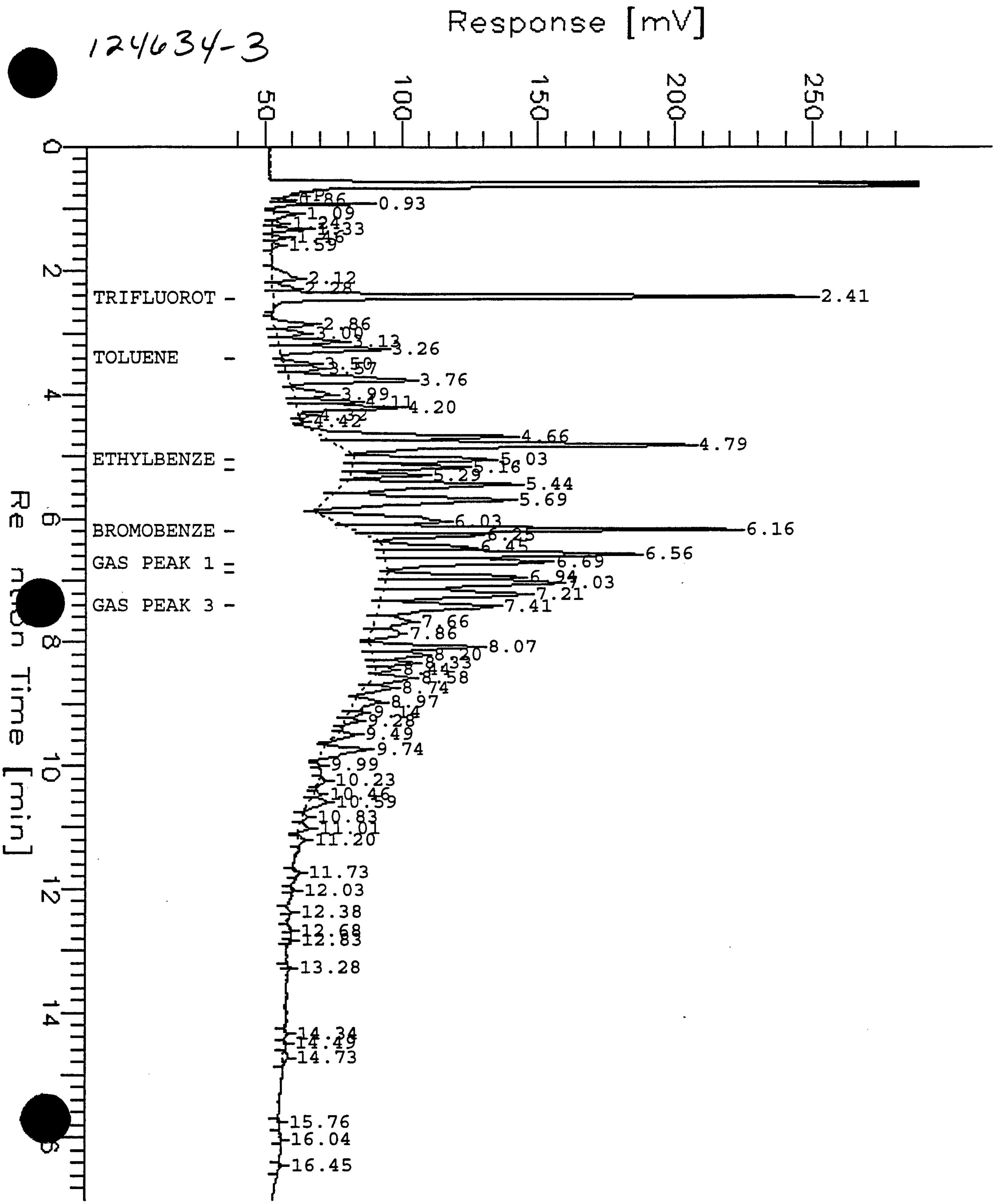
124634-2



TVH2 - GC-04 RTX-1

FileName : G:\GC04\072J007.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 17.00 min
Plot Offset: 39 mV
Date : 3/12/96 5:24 PM
Low Point : 38.82 mV
Plot Scale: 250 mV
Page 1 of 1
High Point : 288.82 mV

124634-3



C+T Gasoline Std.

FileName : G:\GC04\135J001.raw
Start Time : 0.00 min
Scale Factor: -1

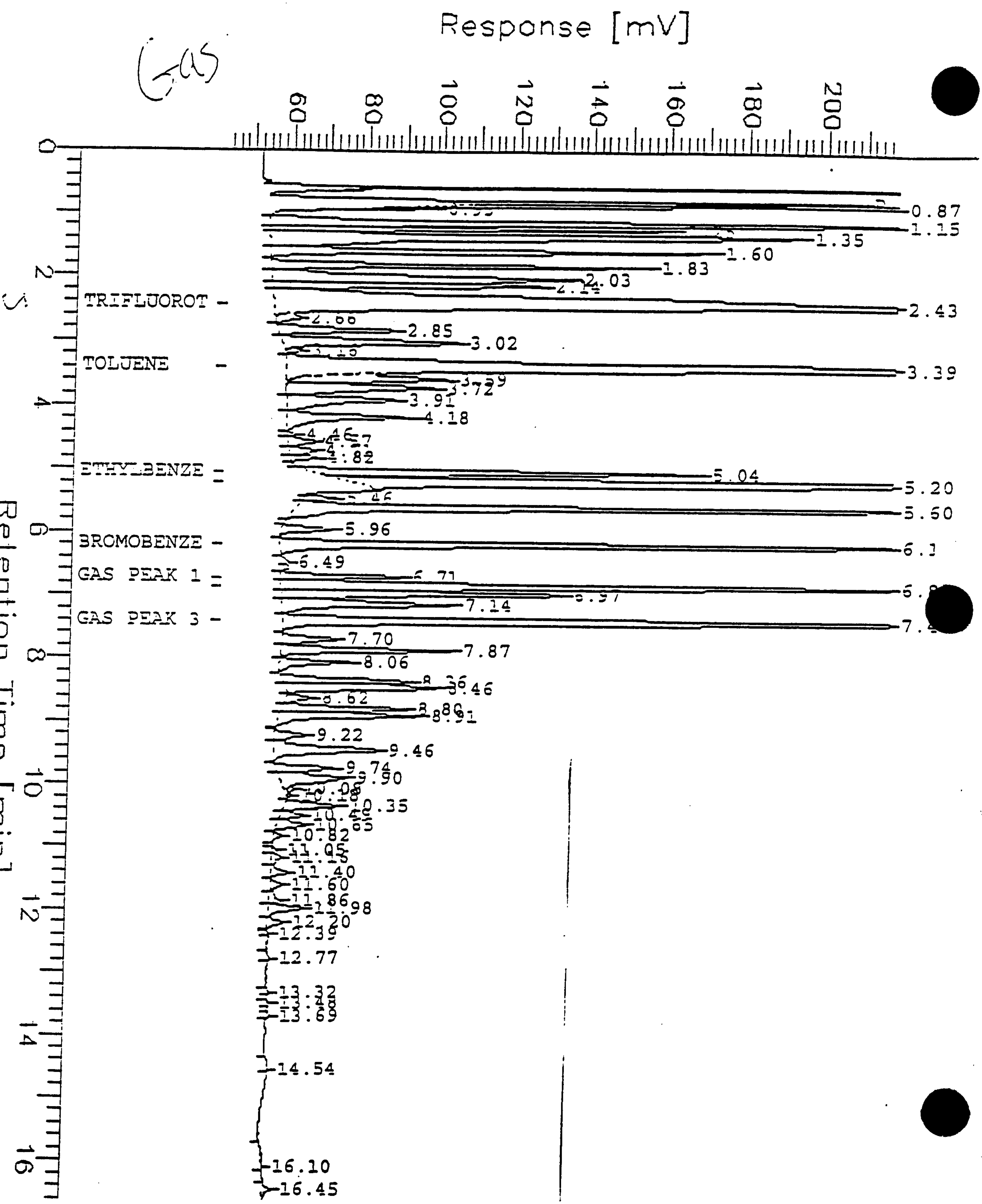
End Time : 17.00 min
Plot Offset: 43 mV

Date : 5/15/95 9:53 AM
Low Point : 42.92 mV
Plot Scale: 175 mV



High Point : 217.92 mV

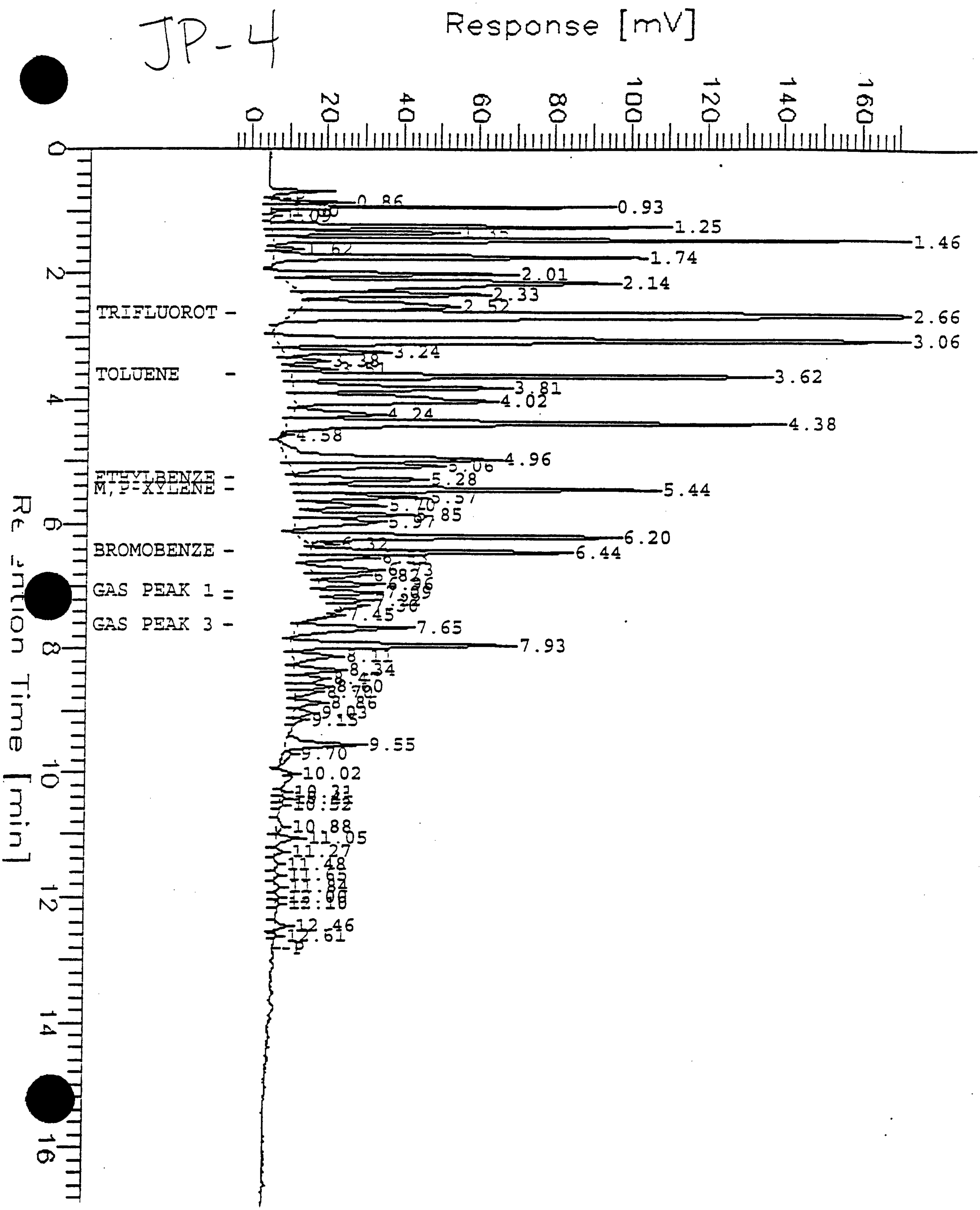
Gas



TVH2 - GC-04 RTX-1

FileName : G:\GC04\B\026J011.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 17.00 min
Plot Offset: -4 mV
Date : 2/1/95 3:57 PM
Low Point : -4.15 mV
Plot Scale: 175 mV
Page 1 of 1
High Point : 170.85 mV

JP-4



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## BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124634-001 | BE-MP15-9.5 | 26389 | 02/27/96 | 03/12/96 | 03/12/96 | 10% |
| 124634-002 | BE-MP10-5.5 | 26389 | 02/28/96 | 03/12/96 | 03/12/96 | 10% |
| 124634-003 | BE-MP11-7.0 | 26389 | 02/28/96 | 03/12/96 | 03/12/96 | 12% |
| 124634-004 | BE-MP19-7.0 | 26345 | 02/28/96 | 03/12/96 | 03/12/96 | 9% |

| Analyte<br>Diln Fac: | Units | 124634-001<br>1 | 124634-002<br>200 | 124634-003<br>25 | 124634-004<br>1 |
|---|---|---|---|---|---|
| Benzene | ug/Kg | <5.6 | <110 | <14 | <5.5 |
| Toluene | ug/Kg | <5.6 | <110 | <14 | <5.5 |
| Ethylbenzene | ug/Kg | <5.6 | <110 | <14 | <5.5 |
| m,p-Xylenes | ug/Kg | 86 C | 2200 C | 160 C | <5.5 |
| o-Xylene | ug/Kg | <5.6 | <110 | <14 | <5.5 |
| 1,2,3-Trimethylbenzene | ug/Kg | 190 | <110 | 110 | <5.5 |
| 1,2,4-Trimethylbenzene | ug/Kg | <5.6 | 180 C | 85 C | <5.5 |
| 1,3,5-Trimethylbenzene | ug/Kg | 90 | <110 | 16 C | <5.5 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 100 | 135 * | 67 | 84 |
| Bromobenzene | %REC | 77 | 77 | 56 | 72 |

* Values outside of QC limits

C: Presence of this compound confirmed by second column, however, the confirmation concentration differed from the reported result by more than a factor of two

Curtis & Tompkins, Ltd



| BTXE | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: EPA 8020<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Soil<br>Batch#: 26345<br>Units: ug/Kg<br>Diln Fac: 1 | Prep Date: 03/11/96<br>Analysis Date: 03/11/96 |

MB Lab ID: QC16891

| Analyte | Result | |
|---|---|---|
| Benzene | <5.0 | |
| Toluene | <5.0 | |
| Ethylbenzene | <5.0 | |
| m,p-Xylenes | <5.0 | |
| o-Xylene | <5.0 | |
| 1,2,3-Trimethylbenzene | <5.0 | |
| 1,2,4-Trimethylbenzene | <5.0 | |
| 1,3,5-Trimethylbenzene | <5.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 87 | 43-114 |
| Bromobenzene | 71 | 45-140 |

Curtis & Tompkins, Ltd

Lab #: 124634

BATCH QC REPORT



## BTXE

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

## METHOD BLANK

| | | | |
|---|---|---|---|
| Matrix: | Soil | Prep Date: | 03/12/96 |
| Batch#: | 26389 | Analysis Date: | 03/12/96 |
| Units: | ug/Kg | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC16980

| Analyte | Result |
|---|---|
| Benzene | <5.0 |
| Toluene | <5.0 |
| Ethylbenzene | <5.0 |
| m,p-Xylenes | <5.0 |
| o-Xylene | <5.0 |
| 1,2,3-Trimethylbenzene | <5.0 |
| 1,2,4-Trimethylbenzene | <5.0 |
| 1,3,5-Trimethylbenzene | <5.0 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| Trifluorotoluene | 94 | 43-114 |
| Bromobenzene | 82 | 45-140 |

Curtis & Tompkins, Ltd.

Lab #: 124634 BATCH QC REPORT 

BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26345
Units: ug/Kg
Diln Fac: 1

Prep Date: 03/11/96
Analysis Date: 03/11/96

LCS Lab ID: QC16893

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 106 | 100 | 106 | 80-120 |
| Toluene | 109 | 100 | 109 | 80-120 |
| Ethylbenzene | 105 | 100 | 105 | 80-120 |
| m,p-Xylenes | 214 | 200 | 107 | 80-120 |
| o-Xylene | 109 | 100 | 109 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 89 | 43-114 |
| Bromobenzene | 74 | 45-140 |

Column to be used to flag recovery and RPD values with an asterisk
alues outside of QC limits
ke Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd



BTXE

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

LABORATORY CONTROL SAMPLE

| | | | |
|---|---|---|---|
| Matrix: | Soil | Prep Date: | 03/13/96 |
| Batch#: | 26389 | Analysis Date: | 03/13/96 |
| Units: | ug/Kg | | |
| Diln Fac: | 1 | | |

LCS Lab ID: QC16982

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 98 | 100 | 98 | 80-120 |
| Toluene | 100 | 100 | 100 | 80-120 |
| Ethylbenzene | 95 | 100 | 95 | 80-120 |
| m,p-Xylenes | 191 | 200 | 96 | 80-120 |
| o-Xylene | 102 | 100 | 102 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 87 | 43-114 |
| Bromobenzene | 74 | 45-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd

Lab #: 124634

BATCH QC REPORT



BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124736-001
Matrix: Soil
Batch#: 26345
Units: ug/Kg dry weight
Diln Fac: 1

Sample Date: 02/26/96
Received Date: 02/29/96
Prep Date: 03/11/96
Analysis Date: 03/11/96
Moisture: 8%

MS Lab ID: QC16894

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Benzene | 108.7 | <5.435 | 109.8 | 101 | 75-125 |
| Toluene | 108.7 | <5.435 | 105.4 | 97 | 75-125 |
| Ethylbenzene | 108.7 | <5.435 | 83.7 | 77 | 75-125 |
| m,p-Xylenes | 217.4 | <5.435 | 157.6 | 72 * | 75-125 |
| o-Xylene | 108.7 | <5.435 | 115.2 | 106 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 93 | 43-114 |
| Bromobenzene | 69 | 45-140 |

MSD Lab ID: QC16895

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Benzene | 108.7 | 98.91 | 91 | 75-125 | 10 | <20 |
| Toluene | 108.7 | 90.22 | 83 | 75-125 | 16 | <20 |
| Ethylbenzene | 108.7 | 71.74 | 66 * | 75-125 | 15 | <20 |
| m,p-Xylenes | 217.4 | 132.6 | 61 * | 75-125 | 17 | <20 |
| o-Xylene | 108.7 | 108.7 | 100 | 75-125 | 6 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 93 | 43-114 |
| Bromobenzene | 70 | 45-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 5 outside limits
Spike Recovery: 3 out of 10 outside limits

**PARSONS ENGINEERING SCIENCE, INC.**

1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

12 4659

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020

Project Name/Location: Beale AFB, UST Site

Project Manager: Todd Wiedemeier (Denver, CO)

Site Manager: Michael Phelps (Alameda, CA)

Sampler(s): (Initials and Signature(s))
MAP Mue Bleg
MLP Marcus L. Preie

Note: All analyses and holding times according to AFCEE handbook requirements.

| | | | | | | | | ANALYTES (METHOD) ORGANICS | | | | | | | INORGANICS | | | | | | | OTHER | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample ID | Date | Time | Begin Depth | End Depth | Matrix | NO. OF CONTAINERS | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see notes 1, 2 | Leachable TPH (DI-WET/8015m) notes 1,2,3 | BTEX and TMBs (5030/8020) see notes 1,4 | Halogenated VOCs (5030/8010) see note 1 | SVOCs (3550/8270) | TOC (9060) | TKN (E351.2) | Alkalinity (Std Meth 403) | Total Phosphorus (E365.3) | Total Iron (6010 trace) | pH (9045) | Moisture Content (ASTM D-2216) | Grain-size (ASTM D-422) | | | Remarks |
| 1 | BE-MP15-9.5 | 2/27/96 | 1720 | 9.5 | 10.0 | soil | 1 | X | X | | X | | | | | | | | | | | | | TMBs, note 4 |
| 2 | BE-MP10-5.5 | 2/28/96 | 1130 | 5.5 | 6.0 | soil | 1 | X | X | | X | | | | | | | | | | | | | " " |
| 3 | BE-MP11-7.0 | 2/28/96 | 1400 | 7.0 | 7.5 | soil | 1 | X | X | | X | | | | | | | | | | | | | " " |
| 4 | BE-MP19-7.0 | 2/28/96 | 1640 | 7.0 | 7.5 | soil | 1 | X | X | | X | | | X | | | | | | | | | | " " |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | 4.0 |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | TEMP. RECEIVED: |
| | | | | | | soil | | | | | | | | | | | | | | | | | | RECEIVED BY: |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | | |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| Mue Bleg | 2/29/96 | 11 35 | Marcus L. Preie |

NOTES:
1. Secondary column confirmation required.
2. Quantify all carbon ranges: diesel, jet fuel, oil/grease.
3. Deionized water extraction
4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LAB BY: (SIGNATURE) | DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|---|---|---|---|
| Marcus L. Preie | 2/29/96 | 1543 | [signature] | 2/29/96 | 1545 | FAX COC to Site Manager upon check in. |

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

Beale

Curtis & Tompkins, Ltd.

# COOLER RECEIPT CHECKLIST

Login#: 124634 Date Received: 2/29 Number of Coolers: 1
Client: Parsons Project: Beale 722450.14020

A. Preliminary Examination Phase
Date Opened: 2/29 By (print): J. Willis (sign) [signature]

1. Did cooler come with a shipping slip (airbill, etc.)? .......... YES NO
   If YES, enter carrier name and airbill number: ______
2. Were custody seals on outside of cooler? .......... YES NO
   How many and where? ______ Seal date: ______ Seal name: ______
3. Were custody seals unbroken and intact at the date and time of arrival? .......... YES NO N/A
4. Were custody papers dry and intact when received? .......... YES NO
5. Were custody papers filled out properly (ink, signed, etc.)? .......... YES NO
6. Did you sign the custody papers in the appropriate place? .......... YES NO
7. Was project identifiable from custody papers? .......... YES NO
   If YES, enter project name at the top of this form.
8. If required, was sufficient ice used? .......... YES NO
   Type of ice: cube/blue Temperature: 4.0 °C

B. Login Phase
Date Logged In: 2/29 By (print): J. Willis (sign) [signature]

1. Describe type of packing in cooler: ——
2. Did all bottles arrive unbroken? .......... YES NO
3. Were labels in good condition and complete (ID, date, time, signature, etc.)? .......... YES NO
4. Did bottle labels agree with custody papers? .......... YES NO
5. Were appropriate containers used for the tests indicated? .......... YES NO
6. Were correct preservatives added to samples? .......... YES NO
7. Was sufficient amount of sample sent for tests indicated? .......... YES NO
8. Were bubbles absent in VOA samples? If NO, list sample Ids below .......... YES NO N/A
9. Was the client contacted concerning this sample delivery? .......... YES NO
   If YES, give details below.
   Who was called? ______ By whom? ______ Date: ______

Additional Comments:

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# ANALYTICAL REPORT

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 21-MAR-96
Lab Job Number: 124647
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Tina K Morrison

Reviewed by:

Curtis & Tompkins, Ltd

**Laboratory Number: 124647**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 03/01/96**
**Receipt Date:03/02/96**

## CASE NARRATIVE

Curtis & Tompkins Ltd. received three soil samples from the above referenced project on March 1,1996. All samples were received cold and intact. The chain of custody requested matrix spike and spike duplicate on sample BE-MP01-5 (C&T# 124647-002), however, a large fraction of each of these samples were large pebbles and rocks. There was not enough soil to perform spikes on any of the samples in this set. Chromatograms are included in this report for any samples containing quantifiable concentrations of extractable or purgeable hydrocarbons, along with example chromatograms for each type of fuel.

**TPH/Extractable:** The "Z" qualifier flag appears for sample BE-MP23-6.5 (C&T# 124647-001) indicating that the sample chromatogram does not resemble a fuel pattern, but consists of individual, strongly differentiated peaks.

**TPH/Purgeable:** No analytical problems were encountered.

**BTXE + TMBs (EPA 8020):** Ethyl-benzene and xylene matrix spike and spike duplicate recoveries failed QC limits due to high levels of non-target hydrocarbons present in the spiked sample. The sample spiked was not from Beale AFB and the associated laboratory control sample passed all acceptance criteria.

## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M)
Project#: 722450.14020 | Prep Method: LUFT
Location: Beale AFB

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124647-001 | BE-MP23-6.5 | 26268 | 03/01/96 | 03/05/96 | 03/08/96 | 12% |
| 124647-002 | BE-MP01-5 | 26268 | 03/01/96 | 03/05/96 | 03/09/96 | 12% |
| 124647-003 | BE-MP43-7.0 | 26268 | 03/01/96 | 03/05/96 | 03/08/96 | 13% |

| Analyte | Units | 124647-001 | 124647-002 | 124647-003 |
|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | 1 |
| JP5 | mg/Kg | 1.9Z | <1.1 | <1.1 |
| Diesel Range | mg/Kg | <1.1 | 4.4YH | <1.1 |
| Motor Oil Range | mg/Kg | <5.7 | 51 | <5.7 |
| Surrogate | | | | |
| Hexacosane | %REC | 107 | 92 | 97 |

Y: Sample exhibits fuel pattern which does not resemble standard
Z: Sample exhibits unknown single peak or peaks
H: Heavier hydrocarbons than indicated standard

Curtis & Tompkins, Ltd



## TEH-Tot Ext Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: LUFT |
| Location: Beale AFB | |

## METHOD BLANK

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/05/96 |
| Batch#: 26268 | Analysis Date: 03/08/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

MB Lab ID: QC16519

| Analyte | Result | |
|---|---|---|
| JP5 | <1.0 | |
| Diesel Range | <1.0 | |
| Motor Oil Range | <5.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 69 | 60-140 |

Curtis & Tompkins, Ltd.



## TEH-Tot Ext Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | LUFT |
| Location: | Beale AFB | | |

## LABORATORY CONTROL SAMPLE

| | | | |
|---|---|---|---|
| Matrix: | Soil | Prep Date: | 03/05/96 |
| Batch#: | 26268 | Analysis Date: | 03/08/96 |
| Units: | mg/Kg | | |
| Diln Fac: | 1 | | |

LCS Lab ID: QC16520

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Diesel Range | 40.1 | 49.5 | 81 | 60-140 |
| **Surrogate** | **%Rec** | **Limits** | | |
| Hexacosane | 69 | 60-140 | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd

Lab #: 124647

# BATCH QC REPORT



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: LUFT

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124641-004
Matrix: Soil
Batch#: 26268
Units: mg/Kg dry weight
Diln Fac: 1

Sample Date: 02/27/96
Received Date: 03/01/96
Prep Date: 03/05/96
Analysis Date: 03/08/96
Moisture: 35%

MS Lab ID: QC16521

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Diesel Range | 76.15 | <1.538 | 71.69 | 94 | 60-140 |
| Surrogate | %Rec | Limits | | | |
| Hexacosane | 82 | 60-140 | | | |

MSD Lab ID: QC16522

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Diesel Range | 76.15 | 63.54 | 83 | 60-140 | 12 | <30 |
| Surrogate | %Rec | Limits | | | | |
| Hexacosane | 74 | 60-140 | | | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

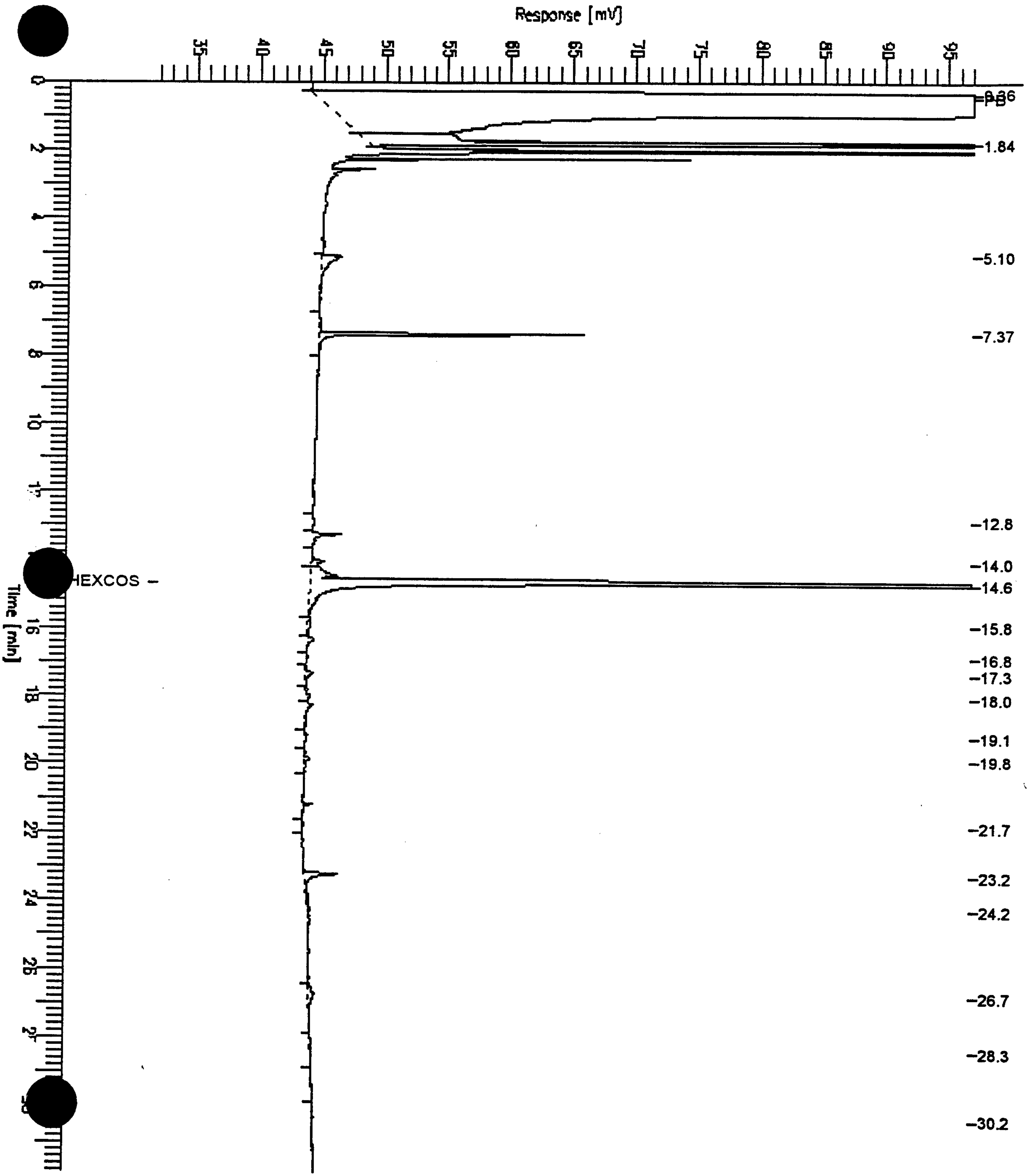
# GC15 Channel A Surrogate

Sample Name : S,124647-001,26268
FileName : C:\GC15\CHB\068B009.raw
Method : DUAL
Start Time : 0.00 min
Factor: 0.0
End Time : 31.90 min
Plot Offset: 32 mV

Sample #: 26268
Date : 3/8/96 11:26 PM
Time of Injection: 3/8/96 10:53 PM
Low Point : 32.00 mV
Plot Scale: 65.0 mV



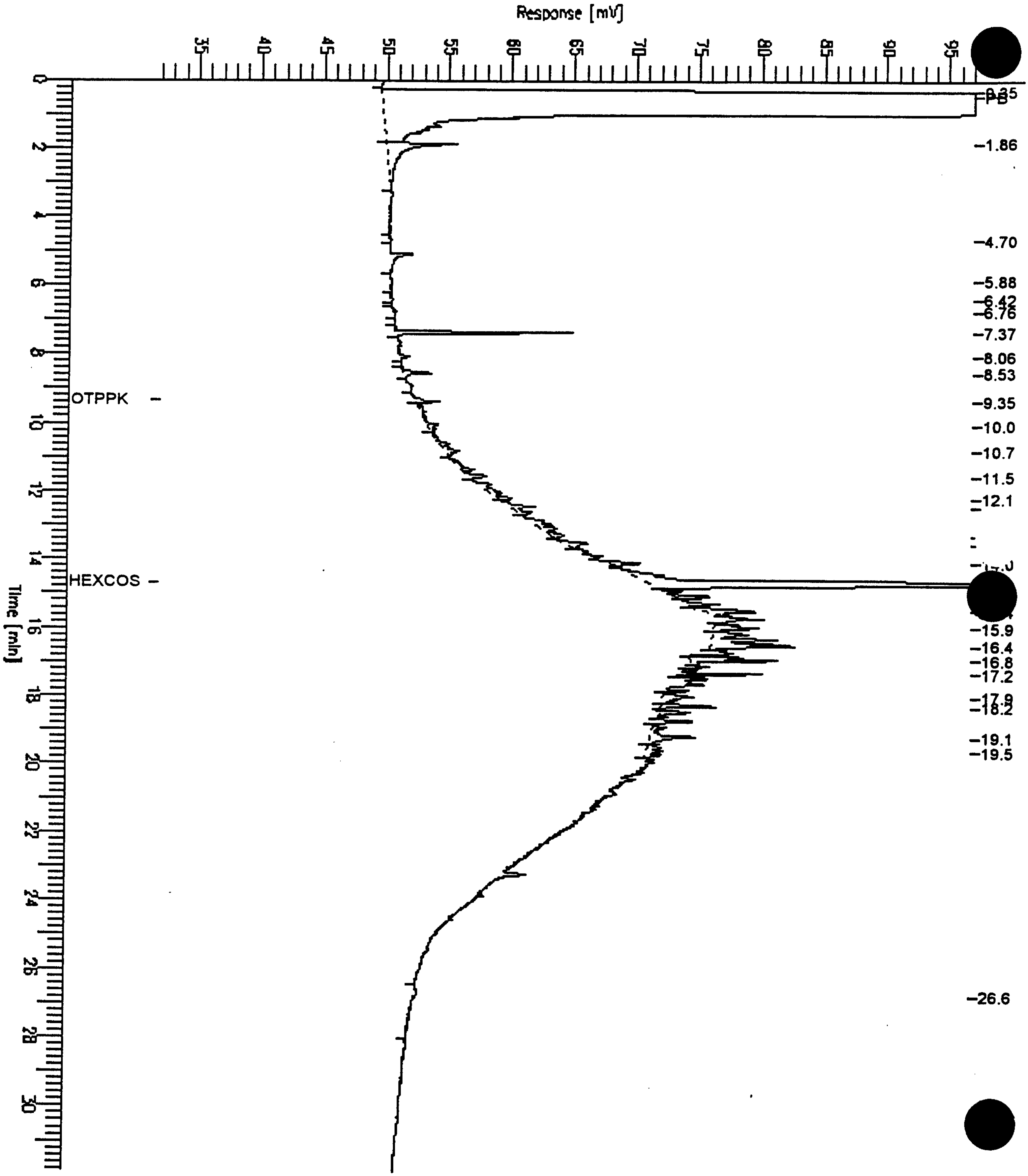
High Point : 97.00 mV



Sample Name : S,124647-002,26268
FileName : C:\GC15\CHB\068B022.raw
Method : DUAL
Start Time : 0.00 min
End Time : 31.90 min
Scale Factor: 0.0
Plot Offset: 32 mV

Sample #: 26268
Date : 3/9/96 08:55 AM
Time of Injection: 3/9/96 08:22 AM
Low Point : 32.00 mV
High Point : 97.00 mV
Plot Scale: 65.0 mV





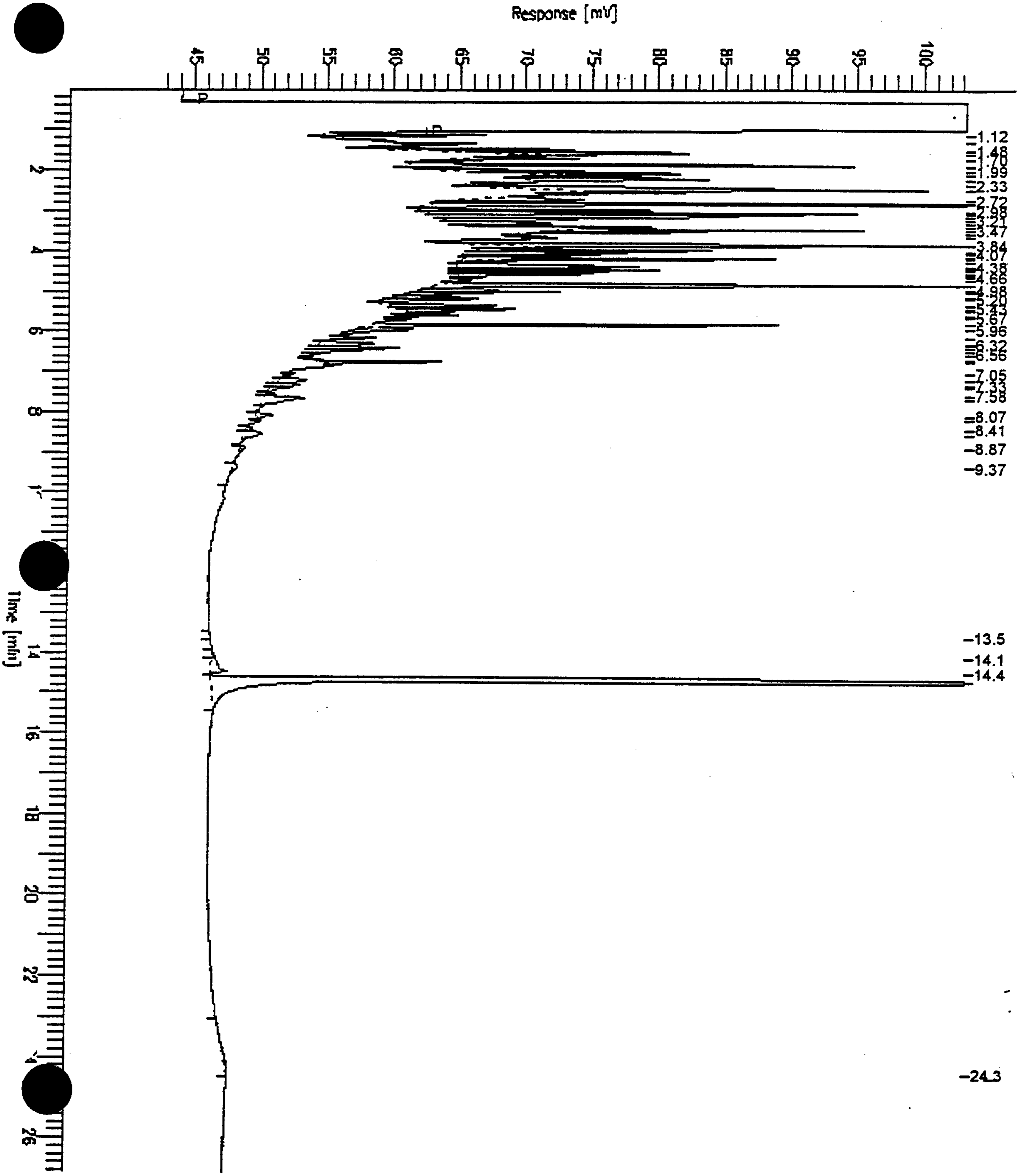
JP-5

# GC15 Channel A TEH

Sample Name : CCV,JP5
FileName : C:\GC15\CHB\067B023.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Factor: 0.0
End Time : 26.87 min
Plot Offset: 42 mV

Sample #: 250MG/L
Date : 3/8/96 01:50 PM
Time of Injection: 3/8/96 07:20 AM
Low Point : 42.42 mV
Plot Scale: 60.8 mV
High Point : 103.22 mV





GC15 Channel A TEH

Diesel

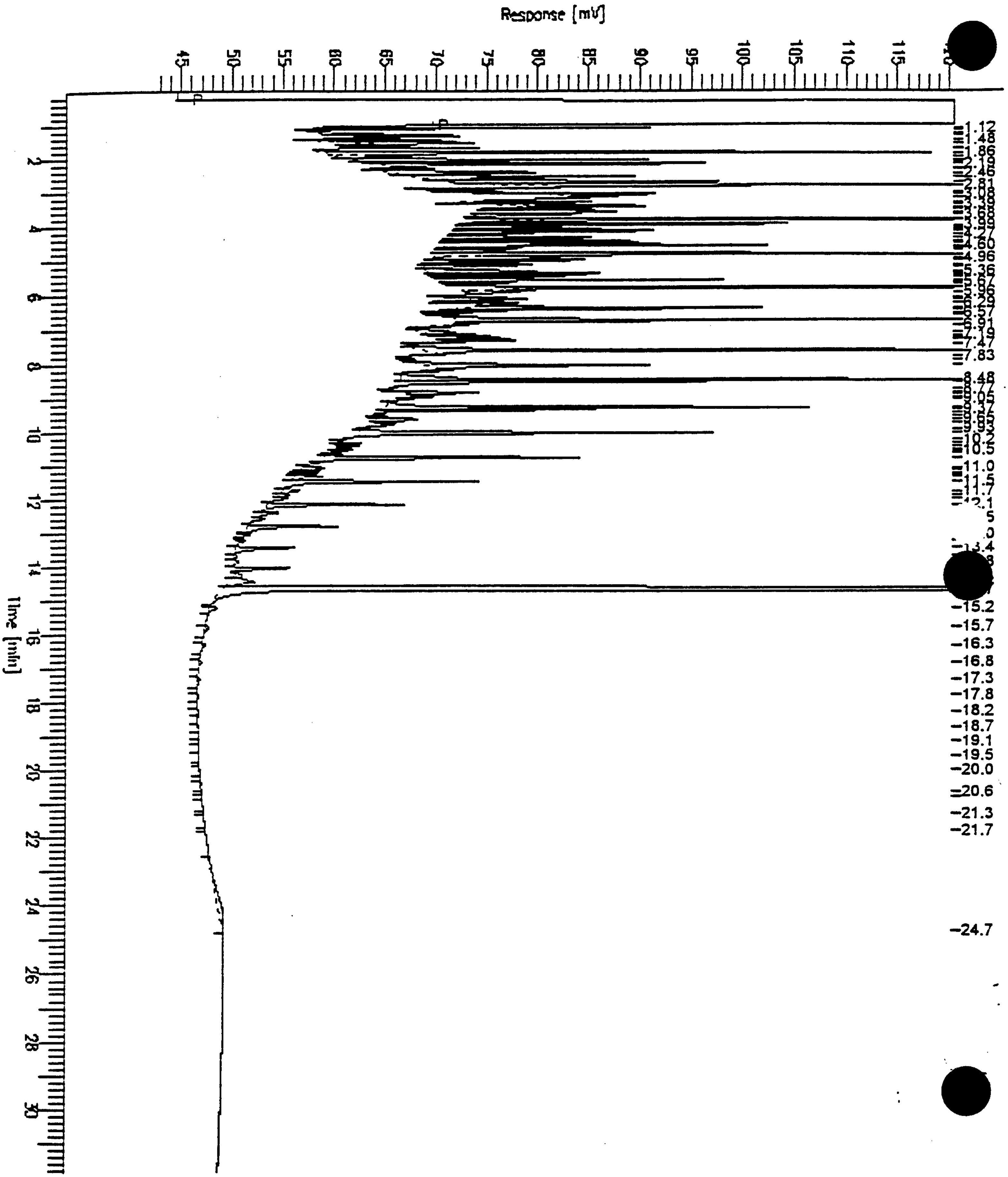
Sample Name : CCV,96WS1948,DSL
FileName : C:\GC15\CHB\067B021.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0

End Time : 31.91 min
Plot Offset: 42 mV

Sample #: DSL
Date : 3/8/96 01:45 PM
Time of Injection: 3/8/96 05:52 AM
Low Point : 42.49 mV
Plot Scale: 78.0 mV



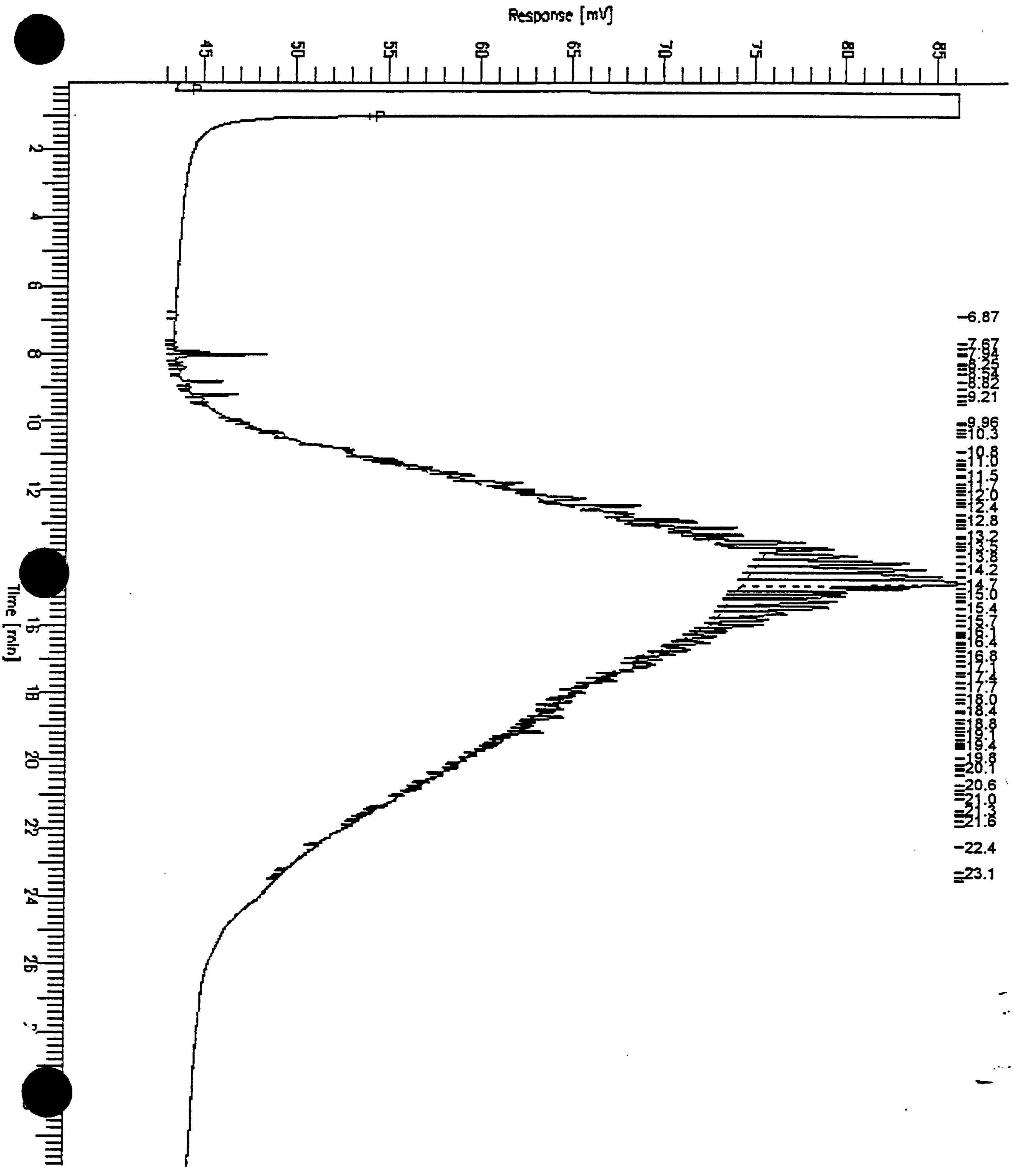
High Point : 120.49 mV



motor oil

# GC15 Channel A TEH

Sample Name : MO, 95US 1596mg/L 500mg/L
FileName : C:\GC15\CHB\067B008.RAW
Method : BTEH.MTH
Start Time : 0.01 min
End Time : 31.91 min
Plot Offset: 42 mV
Sample #:
Page 1 of 1
Date : 3/8/96 02:01 PM
Time of Injection: 3/7/96 08:23 PM
Low Point : 42.50 mV
High Point : 86.16 mV
Plot Scale: 43.7 mV



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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124647-001 | BE-MP23-6.5 | 26407 | 03/01/96 | 03/14/96 | 03/14/96 | 12% |
| 124647-002 | BE-MP01-5 | 26345 | 03/01/96 | 03/11/96 | 03/11/96 | 12% |
| 124647-003 | BE-MP43-7.0 | 26345 | 03/01/96 | 03/12/96 | 03/12/96 | 13% |

| Analyte<br>Diln Fac: | Units | 124647-001<br>1 | 124647-002<br>1 | 124647-003<br>1 |
|---|---|---|---|---|
| Gasoline | mg/Kg | <1.1 | <1.1 | <1.1 |
| Surrogate | | | | |
| Trifluorotoluene | %REC | 93 | 92 | 90 |
| Bromobenzene | %REC | 86 | 81 | 78 |

Curtis & Tompkins, Ltd.

Lab #: 124647

BATCH QC REPORT



| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: CA LUFT (EPA 8015M)<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Soil<br>Batch#: 26345<br>Units: mg/Kg<br>Diln Fac: 1 | Prep Date: 03/11/96<br>Analysis Date: 03/11/96 |

MB Lab ID: QC16891

| Analyte | Result | |
|---|---|---|
| Gasoline | <1.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 93 | 52-127 |
| Bromobenzene | 78 | 47-112 |

Curtis & Tompkins, Ltd



| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| METHOD BLANK | |
|---|---|
| Matrix: Soil | Prep Date: 03/13/96 |
| Batch#: 26407 | Analysis Date: 03/13/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

MB Lab ID: QC17054

| Analyte | Result | |
|---|---|---|
| Gasoline | <1.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 87 | 52-127 |
| Bromobenzene | 74 | 47-112 |

Curtis & Tompkins, Ltd

Lab #: 124647

# BATCH QC REPORT



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/11/96 |
| Batch#: 26345 | Analysis Date: 03/11/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

LCS Lab ID: QC16892

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 10.1 | 10 | 101 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 106 | 52-127 |
| Bromobenzene | 90 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd.



## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

### LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26407
Units: mg/Kg
Diln Fac: 1

Prep Date: 03/13/96
Analysis Date: 03/13/96

LCS Lab ID: QC17055

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 9.1 | 10 | 91 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 96 | 52-127 |
| Bromobenzene | 86 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124735-013
Matrix: Soil
Batch#: 26407
Units: mg/Kg dry weight
Diln Fac: 1

Sample Date: 03/05/96
Received Date: 03/08/96
Prep Date: 03/13/96
Analysis Date: 03/13/96
Moisture: 9%

MS Lab ID: QC17057

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 10.99 | <1.099 | 10.11 | 92 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 100 | 52-127 |
| Bromobenzene | 89 | 47-112 |

MSD Lab ID: QC17058

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 10.99 | 10 | 91 | 75-125 | 1 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 101 | 52-127 |
| Bromobenzene | 91 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

Curtis & Tompkins, Ltd



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124647-001 | BE-MP23-6.5 | 26407 | 03/01/96 | 03/14/96 | 03/14/96 | 12% |
| 124647-002 | BE-MP01-5 | 26345 | 03/01/96 | 03/11/96 | 03/11/96 | 12% |
| 124647-003 | BE-MP43-7.0 | 26345 | 03/01/96 | 03/12/96 | 03/12/96 | 13% |

| Analyte | Units | 124647-001 | 124647-002 | 124647-003 |
|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | 1 |
| Benzene | ug/Kg | <5.7 | <5.7 | <5.7 |
| Toluene | ug/Kg | <5.7 | <5.7 | <5.7 |
| Ethylbenzene | ug/Kg | <5.7 | <5.7 | <5.7 |
| m,p-Xylenes | ug/Kg | <5.7 | <5.7 | <5.7 |
| o-Xylene | ug/Kg | <5.7 | <5.7 | <5.7 |
| 1,2,3-Trimethylbenzene | ug/Kg | <5.7 | <5.7 | <5.7 |
| 1,2,4-Trimethylbenzene | ug/Kg | <5.7 | <5.7 | <5.7 |
| 1,3,5-Trimethylbenzene | ug/Kg | <5.7 | <5.7 | <5.7 |
| **Surrogate** | | | | |
| Trifluorotoluene | %REC | 89 | 88 | 87 |
| Bromobenzene | %REC | 80 | 76 | 73 |

Curtis & Tompkins, Ltd.

Lab #: 124647 BATCH QC REPORT 

| BTXE | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: EPA 8020<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Soil<br>Batch#: 26345<br>Units: ug/Kg<br>Diln Fac: 1 | Prep Date: 03/11/96<br>Analysis Date: 03/11/96 |

MB Lab ID: QC16891

| Analyte | Result | |
|---|---|---|
| Benzene | <5.0 | |
| Toluene | <5.0 | |
| Ethylbenzene | <5.0 | |
| m,p-Xylenes | <5.0 | |
| o-Xylene | <5.0 | |
| 1,2,3-Trimethylbenzene | <5.0 | |
| 1,2,4-Trimethylbenzene | <5.0 | |
| 1,3,5-Trimethylbenzene | <5.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 87 | 43-114 |
| Bromobenzene | 71 | 45-140 |

Curtis & Tompkins, Ltd



**BTXE**

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

**METHOD BLANK**

| | | | |
|---|---|---|---|
| Matrix: | Soil | Prep Date: | 03/13/96 |
| Batch#: | 26407 | Analysis Date: | 03/13/96 |
| Units: | ug/Kg | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC17054

| Analyte | Result |
|---|---|
| Benzene | <5.0 |
| Toluene | <5.0 |
| Ethylbenzene | <5.0 |
| m,p-Xylenes | <5.0 |
| o-Xylene | <5.0 |
| 1,2,3-Trimethylbenzene | <5.0 |
| 1,2,4-Trimethylbenzene | <5.0 |
| 1,3,5-Trimethylbenzene | <5.0 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| Trifluorotoluene | 86 | 43-114 |
| Bromobenzene | 72 | 45-140 |

Curtis & Tompkins, Ltd.

Lab #: 124647 | BATCH QC REPORT | 

**BTXE**

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

**LABORATORY CONTROL SAMPLE**

Matrix: Soil
Batch#: 26345
Units: ug/Kg
Diln Fac: 1

Prep Date: 03/11/96
Analysis Date: 03/11/96

LCS Lab ID: QC16893

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 106 | 100 | 106 | 80-120 |
| Toluene | 109 | 100 | 109 | 80-120 |
| Ethylbenzene | 105 | 100 | 105 | 80-120 |
| m,p-Xylenes | 214 | 200 | 107 | 80-120 |
| o-Xylene | 109 | 100 | 109 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 89 | 43-114 |
| Bromobenzene | 74 | 45-140 |

olumn to be used to flag recovery and RPD values with an asterisk
lues outside of QC limits
ke Recovery: 0 out of 5 outside limits

BATCH QC REPORT



BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26407
Units: ug/Kg
Diln Fac: 1

Prep Date: 03/14/96
Analysis Date: 03/14/96

LCS Lab ID: QC17056

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 101 | 100 | 101 | 80-120 |
| Toluene | 103 | 100 | 103 | 80-120 |
| Ethylbenzene | 99 | 100 | 99 | 80-120 |
| m,p-Xylenes | 198 | 200 | 99 | 80-120 |
| o-Xylene | 103 | 100 | 103 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 85 | 43-114 |
| Bromobenzene | 66 | 45-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd.



# BATCH QC REPORT



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124736-001
Matrix: Soil
Batch#: 26345
Units: ug/Kg dry weight
Diln Fac: 1

Sample Date: 02/26/96
Received Date: 02/29/96
Prep Date: 03/11/96
Analysis Date: 03/11/96
Moisture: 8%

MS Lab ID: QC16894

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Benzene | 108.7 | <5.435 | 109.8 | 101 | 75-125 |
| Toluene | 108.7 | <5.435 | 105.4 | 97 | 75-125 |
| Ethylbenzene | 108.7 | <5.435 | 83.7 | 77 | 75-125 |
| m,p-Xylenes | 217.4 | <5.435 | 157.6 | 72 * | 75-125 |
| o-Xylene | 108.7 | <5.435 | 115.2 | 106 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 93 | 43-114 |
| Bromobenzene | 69 | 45-140 |

MSD Lab ID: QC16895

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Benzene | 108.7 | 98.91 | 91 | 75-125 | 10 | <20 |
| Toluene | 108.7 | 90.22 | 83 | 75-125 | 16 | <20 |
| Ethylbenzene | 108.7 | 71.74 | 66 * | 75-125 | 15 | <20 |
| m,p-Xylenes | 217.4 | 132.6 | 61 * | 75-125 | 17 | <20 |
| o-Xylene | 108.7 | 108.7 | 100 | 75-125 | 6 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 93 | 43-114 |
| Bromobenzene | 70 | 45-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 5 outside limits
Spike Recovery: 3 out of 10 outside limits

PARSONS ENGINEERING SCIENCE, INC.

1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020

Project Name/Location: Beale AFB, UST Site

Project Manager: Todd Wiedemeier (Denver, CO)

Site Manager: Michael Phelps (Alameda, CA)

Sampler(s): (Initials and Signature(s))
MBP [signature]

ANALYTES (METHOD): ORGANICS | INORGANICS | OTHER

| | Sample ID | Date | Time | Begin Depth | End Depth | Matrix | No. of Containers | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see notes 1, 2 | Leachable TPH (DI-WET/8015m) notes 1,2,3 | BTEX and TMBs (5030/8020) see notes 1,4 | Halogenated VOCs (5030/8010) see note 1 | SVOCs (3550/8270) | TOC (9060) | TKN (E351.2) | Alkalinity (Std Meth 403) | Total Phosphorus (E365.3) | Total Iron (6010 trace) | pH (9045) | Moisture Content (ASTM D-2216) | Grain-size (ASTM D-422) | Other | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BE-MP23-6.5 | 3/1/96 | 0835 | 6.5 | 7.0 | soil | 1 | X | X | | X | | | | | | | | | | | | |
| | ~~BE-MP01-5~~ | | | | | soil | ~~1~~ | ~~X~~ | ~~X~~ | | ~~X~~ | | | | | | | | | | | | |
| 2 | BE-MPØ1-5 | 3/1/96 | 1000 | 5.0 | 5.5 | soil | 1 | X | X | | X | | | | | | | | | | | | Do MS/MSD on This sample |
| 3 | BE-MP43-7.0 | 3/1/96 | 0835 | 7.0 | 7.5 | soil | 1 | X | X | | X | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |

Note: All analyses and holding times according to AFCEE handbook requirements.

TEMP. RECEIVED: 3.2 °C
RECEIVED BY: [signature]

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| [signature] | 3/1/96 | 1600 | [signature] |
| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LAB BY: (SIGNATURE) |
| | | | [signature] |

NOTES:
1. Secondary column confirmation required.
2. Quantify all carbon ranges: diesel, jet fuel, oil/grease.
3. Deionized water extraction
4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

| DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|
| 3/2/96 | 16:10 | FAX COC upon receipt to site Manager. |

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

Beale

# COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login#: 124647 Date Received: 3/2/96 Number of Coolers: 1

Client: Parsons ES Project: 722450.14020

A. Preliminary Examination Phase

Date Opened: 3/2/96 By (print): J. Goyette (sign)

1. Did cooler come with a shipping slip (airbill, etc.)? .......... YES NO

   If YES, enter carrier name and airbill number: FED EX 1154090965

2. Were custody seals on outside of cooler? .......... YES NO

   How many and where? 1 FRONT Seal date: 3/1 Seal name:

3. Were custody seals unbroken and intact at the date and time of arrival? .......... YES NO
4. Were custody papers dry and intact when received? .......... YES NO
5. Were custody papers filled out properly (ink, signed, etc.)? .......... YES NO
6. Did you sign the custody papers in the appropriate place? .......... YES NO
7. Was project identifiable from custody papers? .......... YES NO

   If YES, enter project name at the top of this form.

8. If required, was sufficient ice used? .......... YES NO

   Type of ice: wet Temperature: 3.2°C

B. Login Phase

Date Logged In: 3/4 By (print): J. Williams (sign)

1. Describe type of packing in cooler: —
2. Did all bottles arrive unbroken? .......... YES NO
3. Were labels in good condition and complete (ID, date, time, signature, etc.)? .......... YES NO
4. Did bottle labels agree with custody papers? .......... YES NO
5. Were appropriate containers used for the tests indicated? .......... YES NO
6. Were correct preservatives added to samples? .......... YES NO
7. Was sufficient amount of sample sent for tests indicated? .......... YES NO
8. Were bubbles absent in VOA samples? If NO, list sample Ids below .......... YES NO n/a
9. Was the client contacted concerning this sample delivery? .......... YES NO

   If YES, give details below.

   Who was called? By whom? Date:

Additional Comments:

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# A N A L Y T I C A L   R E P O R T

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 28-MAR-96
Lab Job Number: 124746
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Teresa K Morrison

Reviewed by:

Curtis & Tompkins, Ltd

Laboratory Number: 124746
Client: Parsons Engineering Science
Project#: 722450.14020
Location: Beale AFB

Sample Date: 03/06,07/96
Receipt Date: 03/08/96

## CASE NARRATIVE

Curtis & Tompkins,Ltd. received six water samples and one trip blank from the above referenced project on March 8, 1996. All samples were received cold and intact.

**TPH/Extractable:** No analytical problems were encountered.

**TPH/Gasoline:** Trifluorotoluene and bromobenzene failed surrogate recovery limits for sample BE-MP14-01 (C&T# 124746-002) due to coelution of sample hydrocarbons with these surrogates. The sample was reanalyzed with similar results, confirming that the failure was due to matrix interferences. The chromatogram for this sample is included in this report. The trip blank was not documented on the chain of custody. The sampling date on the trip blank label was 2/29/96. The analysis was not performed until 3/20/96, which is past the technical holding time.

**BTXE & TMBs:** The trip blank was not documented on the chain of custody. The sampling date on the trip blank label was 2/29/96. The analysis was not performed until 3/20/96, which is past the technical holding time. As BTXE and gasoline are analyzed concurrently, only one set of matrix spikes are performed. The matrix spikes associated with these samples was analyzed for gasoline. The BTXE laboratory control sample passed acceptance criteria.

**ES** ENGINEERING-SCIENCE COMPANIES

# MEMORANDUM TO FILE

JOB NO. 722450. 14050

FILE DESIGNATION Beale AFB, UST Site

DATE 4/4/96 TIME

PHONE CALL FROM Michael Phelps PHONE NO.

PHONE CALL TO PHONE NO.

CONFERENCE WITH

PLACE:

SUBJECT Trip Blanks, Data Packages 124746, 124747

The dates on the labels used for trip blanks submitted on the chain-of-custodies dated 3/7/96 and 3/8/96 were incorrect. They should have reflected the dates on the chain-of-custody. Therefore, the analyses of both trip blanks is within the analytical method hold time.

SIGNED [signature]

Chromatograms are included in this report for any samples containing quantifiable concentrations of extractable or purgeable hydrocarbons, along with example chromatograms for each type of fuel.

**Data Qualifier Flags**

**C:** The "C" qualifier flag indicates that the target compound reported was confirmed by a second analytical column, but that the concentration quantitated on the second column differed from the reported concentration by more than a factor of two. This often happens when the fuel pattern present in the samples does not resemble gasoline.

**DO:** The surrogate recovery could not be calculated due to the dilution required for sample analysis.

**L:** The "L" qualifier flag indicates that the sample chromatogram resembles a fuel pattern, but that the hydrocarbons present are lighter than those seen in a standard of the reported fuel.

**H:** The "H" qualifier flag indicates that the sample chromatogram resembles a fuel pattern, but that the hydrocarbons present are heavier than those seen in a standard of the reported fuel.

**Y:** The "Y" qualifier flag is used to indicate that the sample chromatogram does not resemble the standard for the reported fuel range. This flag is often used in combination with the flags "L" and/or "H".

**Z:** The "Z" qualifier flag indicates that the sample chromatogram does not resemble a fuel pattern, but consists of individual, strongly differentiated peaks.

PARSONS ENGINEERING SCIENCE, INC.

1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

124746

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020

Project Name/Location: Beale AFB, UST Site

Project Manager: Todd Wiedemeier (Denver, CO)

Site Manager: Michael Phelps (Alameda, CA)

Sampler(s): (Initials and Signature(s))

MAP [signature] [signature]

TXT [signature] HRE [signature]

Note: All analyses and holding times according to AFCEE handbook requirements.

| Sample ID | Date | Time | Begin Depth | End Depth | Matrix | NO. OF CONTAINERS | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see note 1 | BTEX and TMBs (5030/8020) see notes 1, 2 | Halogenated VOCs (5030/8010) see notes 1,4 | SVOCs (3550/8270) see note 1 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP-2701 | 3/6/96 | 1540 | — | — | water | 4 | X | X | X | | | TMB's see note 4. |
| BE-MP14-01 | 3/6/96 | 1225 | — | — | water | 4 | X | X | X | | | |
| BE-MP26-01 | 3/6/96 | 1425 | — | — | water | 4 | X | X | X | | | |
| BE-MP24-01 | 3/6/96 | 0930 | — | — | water | 4 | X | X | X | | | |
| BE-MP03-01 | 3/7/96 | 1136 | — | — | water | 4 | X | X | X | | | |
| BE-MP25-01 | 3/7/96 | 0945 | — | — | water | 4 | X | X | X | | | |
| | | | | | water | | | | | | | |
| Trip blank | | | | | water | | | | | | | 4.75 °C |
| [initials] 3/6/96 | | | | | water | | | | | | | TEMP. RECEIVED: [initials] |
| | | | | | water | | | | | | | RECEIVED BY: |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| | | | |

NOTES:
1. Secondary column confirmation required.
2. Quantify all carbon ranges: diesel, jet fuel, oil/grease.
3. Deionized water extraction
4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LAB BY: (SIGNATURE) | DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|---|---|---|---|
| [signature] | 3/7/96 | 1400 | [signature] | 3/8 | 0609 | |

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

Beale

Curtis & Tompkins, Ltd.

# COOLER RECEIPT CHECKLIST

Login#: 124746 Date Received: 3/8 Number of Coolers: 1

Client: Parsons Project: Beale AFB

A. Preliminary Examination Phase

Date Opened: 3/8 By (print): J Wills (sign) [signature]

1. Did cooler come with a shipping slip (airbill, etc.)? .......... YES NO

If YES, enter carrier name and airbill number: Fed Ex 1154092774

2. Were custody seals on outside of cooler? .......... YES NO

How many and where? ____ Seal date: ____ Seal name: ____

3. Were custody seals unbroken and intact at the date and time of arrival? .......... YES NO
4. Were custody papers dry and intact when received? .......... YES NO
5. Were custody papers filled out properly (ink, signed, etc.)? .......... YES NO
6. Did you sign the custody papers in the appropriate place? .......... YES NO
7. Was project identifiable from custody papers? .......... YES NO

If YES, enter project name at the top of this form.

8. If required, was sufficient ice used? .......... YES NO

Type of ice: cube Temperature: 5.0°C

B. Login Phase

Date Logged In: 3/8 By (print): J Wills (sign) [signature]

1. Describe type of packing in cooler: —
2. Did all bottles arrive unbroken? .......... YES NO
3. Were labels in good condition and complete (ID, date, time, signature, etc.)? .......... YES NO
4. Did bottle labels agree with custody papers? .......... YES NO
5. Were appropriate containers used for the tests indicated? .......... YES NO
6. Were correct preservatives added to samples? .......... YES NO
7. Was sufficient amount of sample sent for tests indicated? .......... YES NO
8. Were bubbles absent in VOA samples? If NO, list sample Ids below .......... YES NO
9. Was the client contacted concerning this sample delivery? .......... YES NO

If YES, give details below.

Who was called? ____ By whom? ____ Date: ____

Additional Comments:

Trip blank received

not on COC

JW 3/8/96

logged on hold

CUSTODY SEAL

3/7/96

DATE

SIGNATURE

Filename: F:\qc\forms\cooler.wpd

# CURTIS & TOMPKINS, LTD. BERKELEY LOGIN CHANGE FORM

Reason for change: ✓ Client Request: By: M. Phelps Date/Time: 3/18 Initials: Tk

____ Login Review ____ Data Review

| Current Lab ID | Previous Lab ID | Client ID | Matrix | Add/Cancel | Analysis | Duedate |
|---|---|---|---|---|---|---|
| | | | | | | |
| 124746-7 | | TRIP BLANK | $H_2O$ | Add | TVH/B/TMB | 3/25 |
| | | | | | | |
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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124746-001 | BE-MP27-01 | 26514 | 03/06/96 | 03/20/96 | 03/20/96 | |
| 124746-002 | BE-MP14-01 | 26514 | 03/06/96 | 03/20/96 | 03/20/96 | |
| 124746-003 | BE-MP26-01 | 26514 | 03/06/96 | 03/20/96 | 03/20/96 | |
| 124746-004 | BE-MP24-01 | 26514 | 03/06/96 | 03/20/96 | 03/20/96 | |

| Analyte<br>Diln Fac: | Units | 124746-001<br>1 | 124746-002<br>1 | 124746-003<br>1 | 124746-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | ug/L | <50 | 4000 Y | <50 | <50 |
| Surrogate | | | | | |
| Trifluorotoluene | %REC | 97 | 169 * | 98 | 97 |
| Bromobenzene | %REC | 95 | 129 * | 97 | 96 |

* Values outside of QC limits
Y: Sample exhibits fuel pattern which does not resemble standard

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TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124746-005 | BE-MP03-01 | 26514 | 03/07/96 | 03/20/96 | 03/20/96 | |
| 124746-006 | BE-MP25-01 | 26514 | 03/07/96 | 03/21/96 | 03/21/96 | |
| 124746-007 | TRIP BLANK | 26514 | 02/29/96 | 03/20/96 | 03/20/96 | |

| Analyte<br>Diln Fac: | Units | 124746-005<br>1 | 124746-006<br>1 | 124746-007<br>1 |
|---|---|---|---|---|
| Gasoline | ug/L | <50 | <50 | <50 |
| Surrogate | | | | |
| Trifluorotoluene | %REC | 97 | 98 | 99 |
| Bromobenzene | %REC | 95 | 94 | 94 |

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## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/20/96 |
| Batch#: 26514 | Analysis Date: 03/20/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC17470

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 99 | 69-120 |
| Bromobenzene | 93 | 70-122 |

Curtis & Tompkins, Ltd

Lab #: 124746

BATCH QC REPORT



TVH-Total Volatile Hydrocarbons

lient: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26514
Units: ug/L
Diln Fac: 1

Prep Date: 03/20/96
Analysis Date: 03/20/96

LCS Lab ID: QC17477

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 1979 | 2000 | 99 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 104 | 69-120 |
| Bromobenzene | 107 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
pike Recovery: 0 out of 1 outside limits

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## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

| | |
|---|---|
| Field ID: ZZZZZZ | Sample Date: 03/13/96 |
| Lab ID: 124811-007 | Received Date: 03/14/96 |
| Matrix: Water | Prep Date: 03/20/96 |
| Batch#: 26514 | Analysis Date: 03/20/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MS Lab ID: QC17472

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 2000 | <50.00 | 2004 | 100 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 105 | 69-120 |
| Bromobenzene | 107 | 70-122 |

MSD Lab ID: QC17473

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 2090 | 2000 | 105 | 75-125 | 5 | <20 |

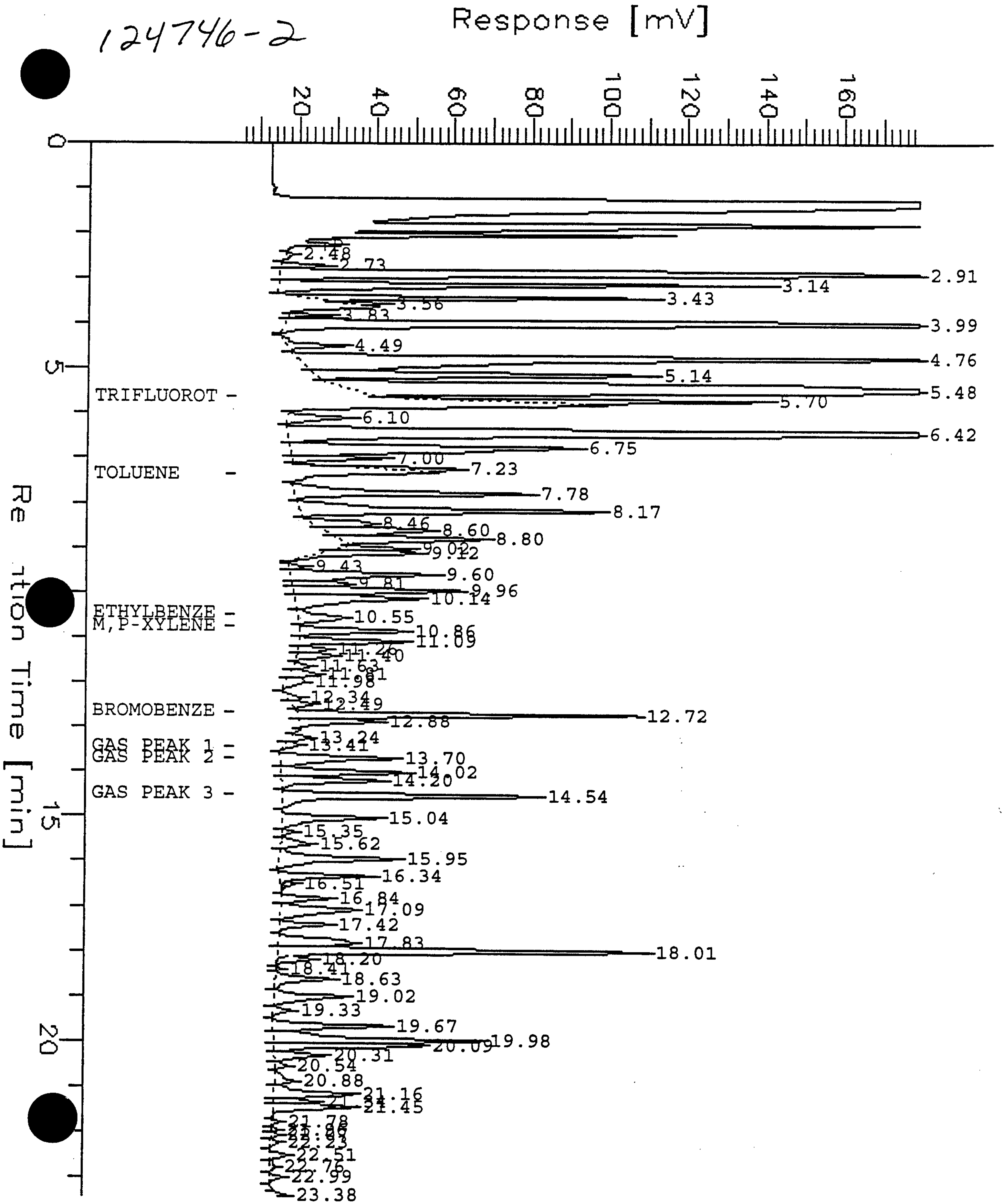
| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 106 | 69-120 |
| Bromobenzene | 113 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

# TVH2 - GC-05 RTX-1

FileName : G:\GC05\080H018.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 23.42 min
Plot Offset: 4 mV
Date : 3/20/96 10:24 PM
Low Point : 4.20 mV
Plot Scale: 175 mV
Page 1 of 1
High Point : 179.20 mV

124746-2



IVH2 - GC-04 RTX-1

C+T Gasoline Std.

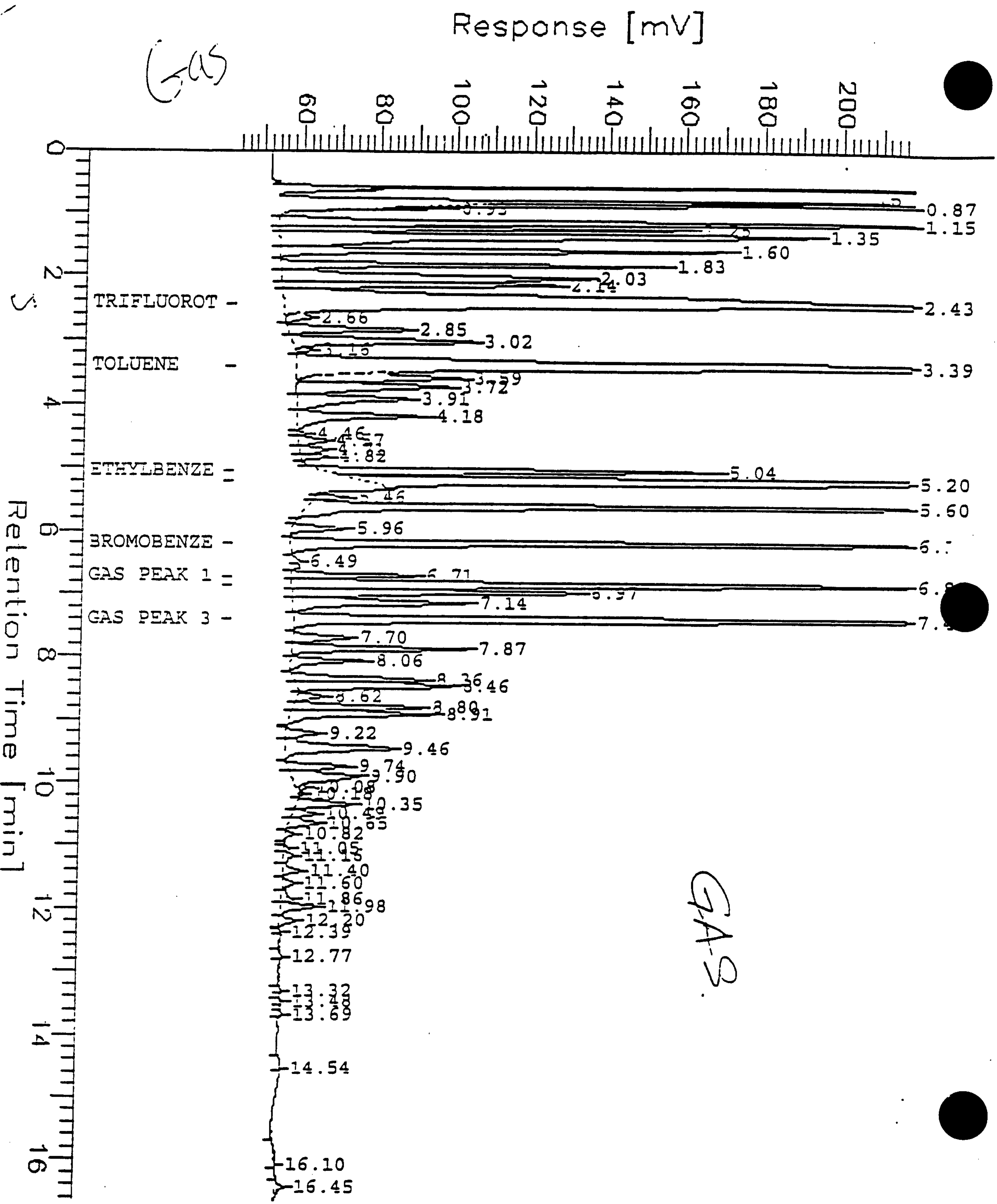
FileName : G:\GC04\135J001.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 17.00 min
Plot Offset: 43 mV

Date : 5/15/95 9:53 AM
Low Point : 42.92 mV
Plot Scale: 175 mV



High Point : 217.92 mV

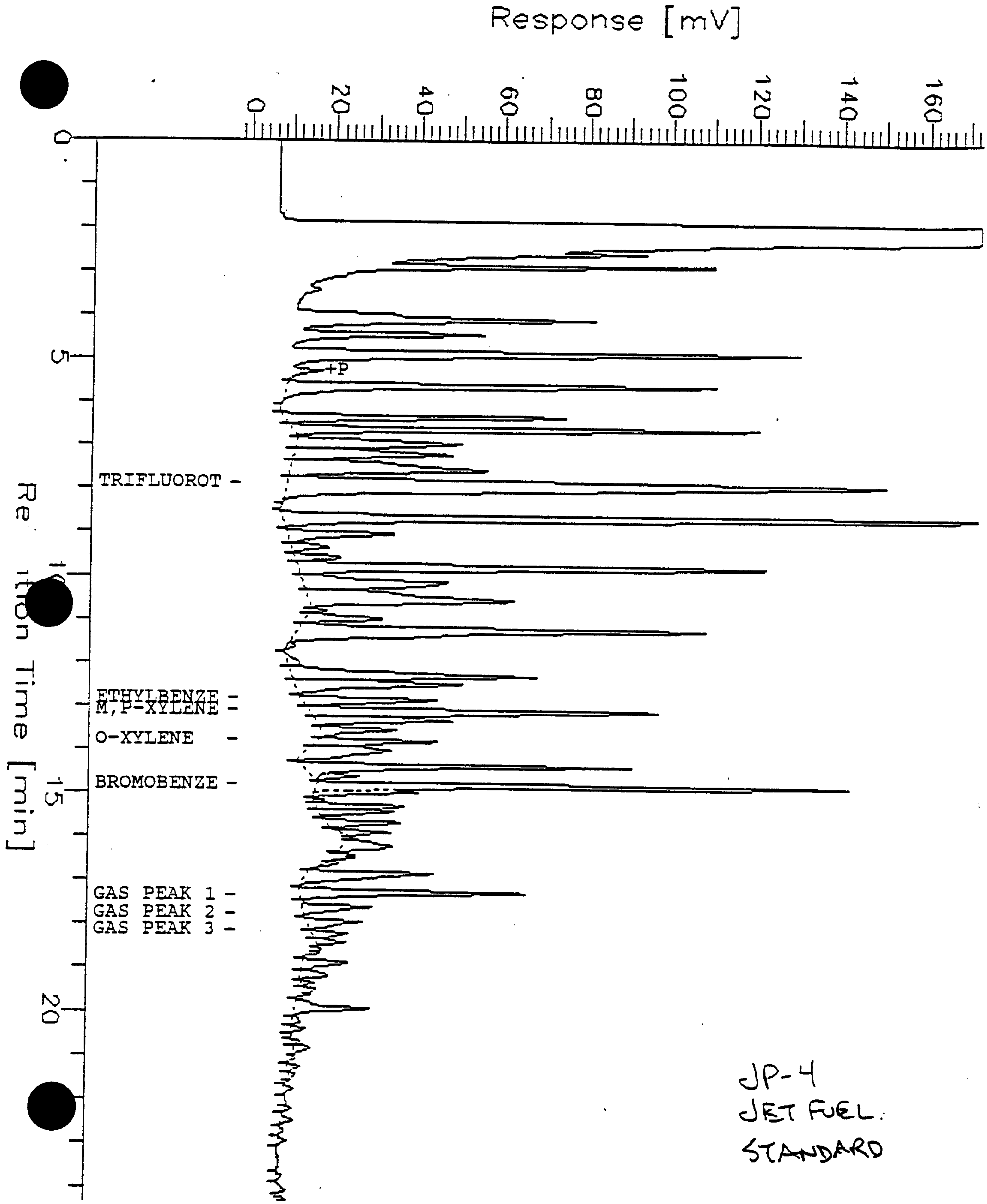


FileName : G:\GC07\271F031.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 24.33 min
Plot Offset: -2 mV

Date : 9/29/93 9:25 AM
Low Point : -2.14 mV
Plot Scale: 175 mV


High Point : 172.86 mV



Curtis & Tompkins, Ltd.



# BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124746-001 | BE-MP27-01 | 26514 | 03/06/96 | 03/20/96 | 03/20/96 | |
| 124746-002 | BE-MP14-01 | 26514 | 03/06/96 | 03/20/96 | 03/20/96 | |
| 124746-003 | BE-MP26-01 | 26514 | 03/06/96 | 03/20/96 | 03/20/96 | |
| 124746-004 | BE-MP24-01 | 26514 | 03/06/96 | 03/20/96 | 03/20/96 | |

| Analyte<br>Diln Fac: | Units | 124746-001<br>1 | 124746-002<br>1 | 124746-003<br>1 | 124746-004<br>1 |
|---|---|---|---|---|---|
| Benzene | ug/L | <0.5 | 9.1C | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | 30 C | <0.5 | <0.5 |
| Ethylbenzene | ug/L | <0.5 | 10 | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | 19 | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | 3.8 | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | 24 | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | 24 | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | 36 | <0.5 | <0.5 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 96 | 91 | 97 | 95 |
| Bromobenzene | %REC | 93 | 89 | 95 | 94 |

C: Presence of this compound confirmed by second column, however, the confirmation concentration differed from the reported result by more than a factor of two

Curtis & Tompkins, Ltd



## BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124746-005 | BE-MP03-01 | 26514 | 03/07/96 | 03/20/96 | 03/20/96 | |
| 124746-006 | BE-MP25-01 | 26514 | 03/07/96 | 03/21/96 | 03/21/96 | |
| 124746-007 | TRIP BLANK | 26514 | 02/29/96 | 03/20/96 | 03/20/96 | |

| Analyte | Units | 124746-005 | 124746-006 | 124746-007 |
|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | 1 |
| Benzene | ug/L | <0.5 | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 | <0.5 |
| Ethylbenzene | ug/L | <0.5 | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 |
| **Surrogate** | | | | |
| Trifluorotoluene | %REC | 95 | 95 | 97 |
| Bromobenzene | %REC | 93 | 94 | 93 |

Curtis & Tompkins, Ltd



## BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/20/96 |
| Batch#: 26514 | Analysis Date: 03/20/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC17470

| Analyte | Result | |
|---|---|---|
| Benzene | <0.5 | |
| Toluene | <0.5 | |
| Ethylbenzene | <0.5 | |
| m,p-Xylenes | <0.5 | |
| o-Xylene | <0.5 | |
| 1,2,3-Trimethylbenzene | <0.5 | |
| 1,2,4-Trimethylbenzene | <0.5 | |
| 1,3,5-Trimethylbenzene | <0.5 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 99 | 58-130 |
| Bromobenzene | 94 | 62-131 |

Curtis & Tompkins, Ltd



BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Water | Prep Date: 03/20/96 |
| Batch#: 26514 | Analysis Date: 03/20/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

LCS Lab ID: QC17471

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 18 | 20 | 90 | 80-120 |
| Toluene | 19 | 20 | 95 | 80-120 |
| Ethylbenzene | 18 | 20 | 90 | 80-120 |
| m,p-Xylenes | 36 | 40 | 90 | 80-120 |
| o-Xylene | 18 | 20 | 90 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 100 | 58-130 |
| Bromobenzene | 95 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
Values outside of QC limits
ke Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd.



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 3520

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124746-001 | BE-MP27-01 | 26390 | 03/06/96 | 03/12/96 | 03/14/96 | |
| 124746-002 | BE-MP14-01 | 26390 | 03/06/96 | 03/12/96 | 03/14/96 | |
| 124746-003 | BE-MP26-01 | 26390 | 03/06/96 | 03/12/96 | 03/14/96 | |
| 124746-004 | BE-MP24-01 | 26390 | 03/06/96 | 03/12/96 | 03/14/96 | |

| Analyte<br>Diln Fac: | Units | 124746-001<br>1 | 124746-002<br>1 | 124746-003<br>1 | 124746-004<br>1 |
|---|---|---|---|---|---|
| JP5 | ug/L | <50 | 1900 YL | <50 | <50 |
| Diesel Range | ug/L | <50 | 2200 YL | <50 | <50 |
| Motor Oil Range | ug/L | <300 | 310 YL | <300 | <300 |
| Surrogate | | | | | |
| Hexacosane | %REC | 70 | 70 | 75 | 72 |

Y: Sample exhibits fuel pattern which does not resemble standard
L: Lighter hydrocarbons than indicated standard

Curtis & Tompkins, Ltd



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 3520

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124746-005 | BE-MP03-01 | 26390 | 03/07/96 | 03/12/96 | 03/13/96 | |
| 124746-006 | BE-MP25-01 | 26390 | 03/07/96 | 03/12/96 | 03/13/96 | |

| Analyte | Units | 124746-005 | 124746-006 |
|---|---|---|---|
| Diln Fac: | | 1 | 1 |
| JP5 | ug/L | <50 | <50 |
| Diesel Range | ug/L | <50 | <50 |
| Motor Oil Range | ug/L | <300 | <300 |
| Surrogate | | | |
| Hexacosane | %REC | 71 | 67 |

Lighter hydrocarbons than indicated standard

Curtis & Tompkins, Ltd



## TEH-Tot Ext Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 3520 |
| Location: Beale AFB | |

## METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/12/96 |
| Batch#: 26390 | Analysis Date: 03/14/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC16985

| Analyte | Result | |
|---|---|---|
| JP5 | <50 | |
| Diesel Range | <50 | |
| Motor Oil Range | <300 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 69 | 60-140 |

Curtis & Tompkins, Ltd.

Lab #: 124746

# BATCH QC REPORT



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 3520

## BLANK SPIKE/BLANK SPIKE DUPLICATE

Matrix: Water
Batch#: 26390
Units: ug/L
Diln Fac: 1

Prep Date: 03/12/96
Analysis Date: 03/13/96

BS Lab ID: QC16986

| Analyte | Spike Added | BS | %Rec | # | Limits |
|---|---|---|---|---|---|
| Diesel Range | 2475 | 2143 | 87 | | 60-140 |
| **Surrogate** | **%Rec** | **Limits** | | | |
| Hexacosane | 65 | 60-140 | | | |

BSD Lab ID: QC16987

| Analyte | Spike Added | BSD | %Rec | # | Limits | RPD | # | Limit |
|---|---|---|---|---|---|---|---|---|
| Diesel Range | 2475 | 2278 | 92 | | 60-140 | 6 | | <35 |
| **Surrogate** | **%Rec** | **Limits** | | | | | | |
| Hexacosane | 68 | 60-140 | | | | | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

TEH Chromatogram - GC 11 Ch B

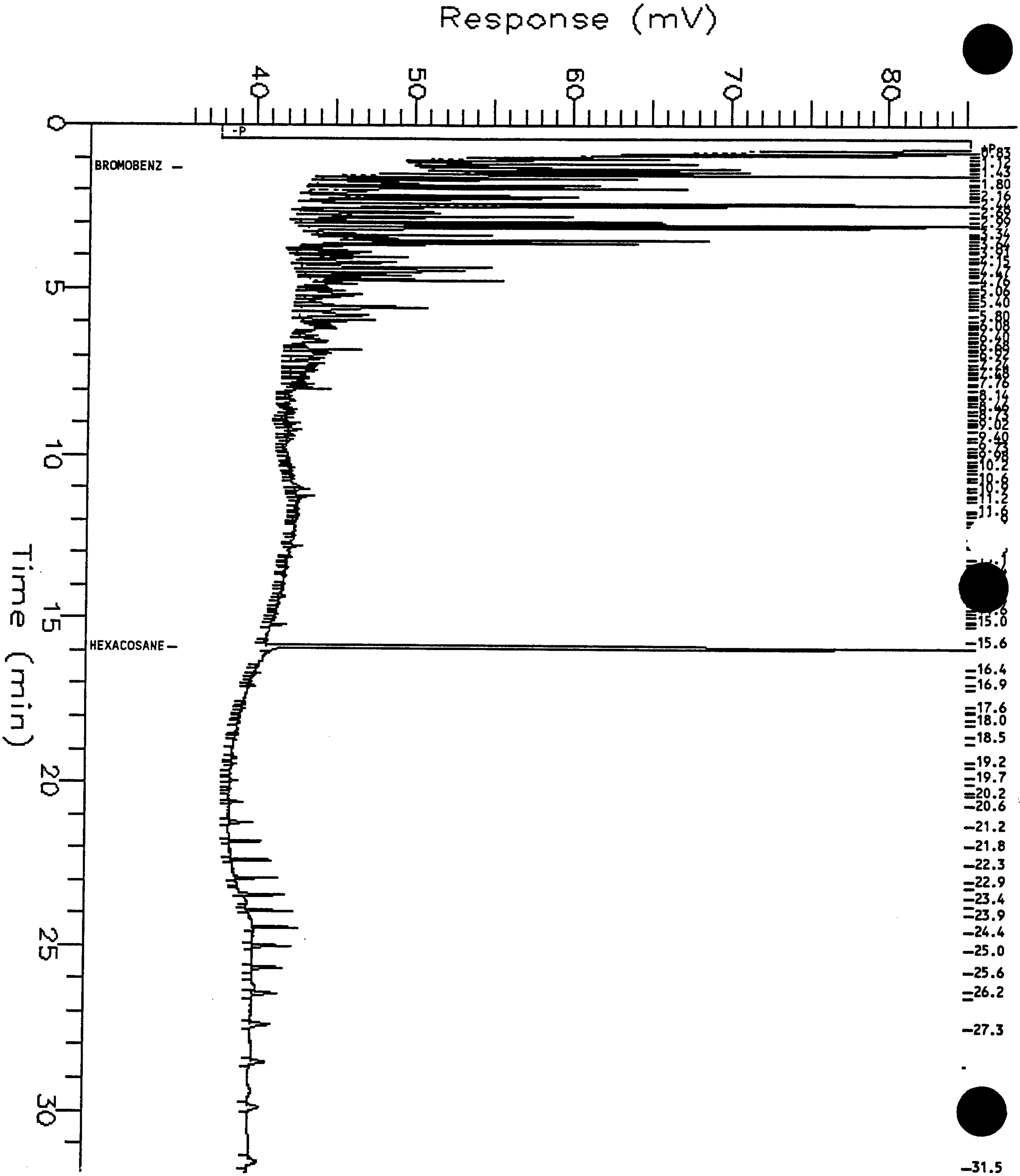
Sample Name : 124746-002,500:2.5
FileName : g:\gc11\chb\073B040.raw
Method : 11B32.ins
Start Time : 0.00 min
Scale Factor: -1

End Time : 31.92 min
Plot Offset: 35 mV

Sample #: 26390
Date : 3/14/96 10:15 AM
Time of Injection: 3/14/96 09:42 AM
Low Point : 35.21 mV
Plot Scale: 50 mV

Page 1 of 1

High Point : 85.21 mV



# TEH Chromatogram - GC 11 Ch B

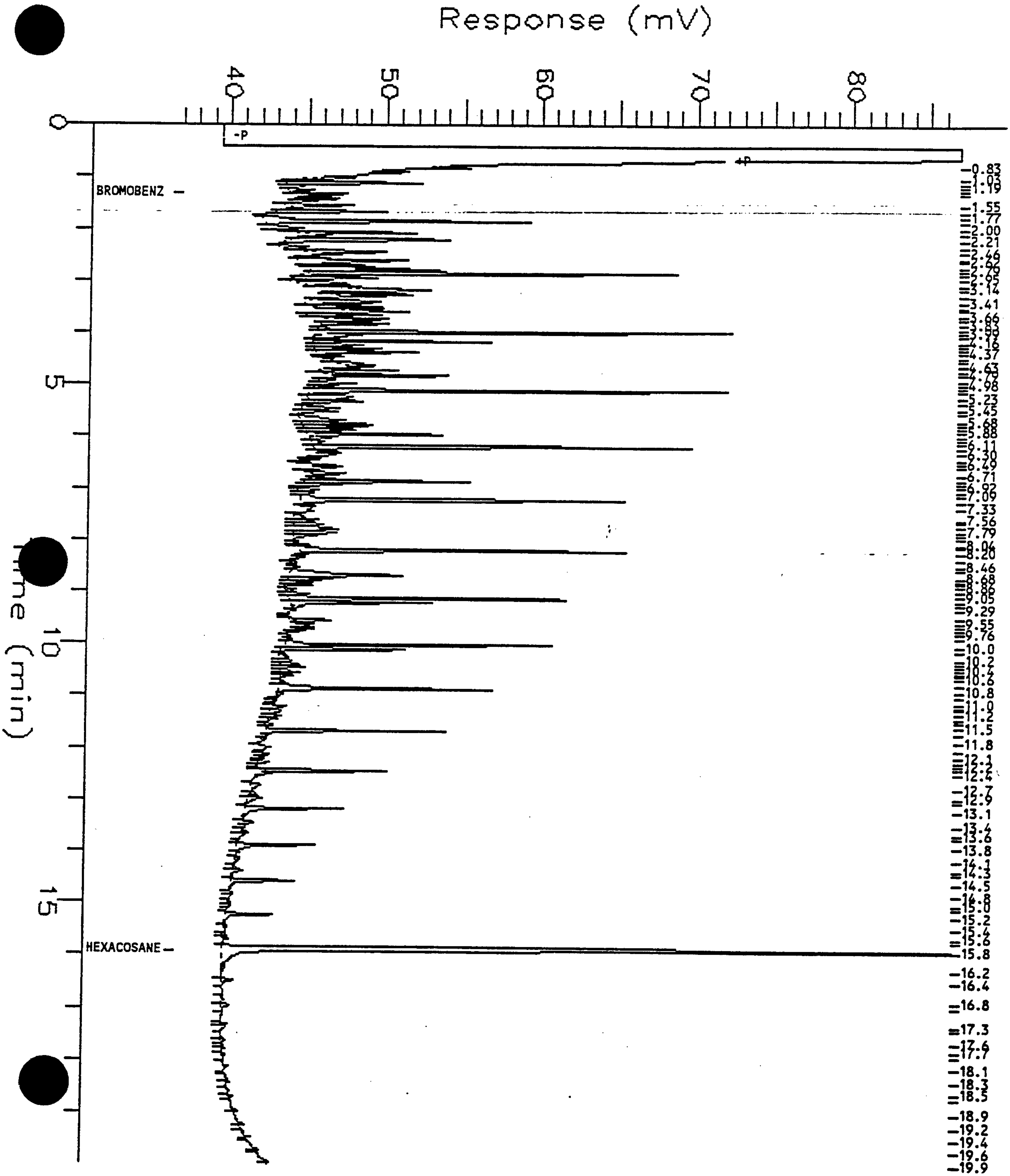
Sample Name : DIESEL 500MG/L
FileName : g:\gc11\chb\073B014.raw
Method : 11B20.ins
Start Time : 0.00 min
·le Factor: -1

End Time : 20.00 min
Plot Offset: 37 mV

Sample #: 96WS1948
Date : 3/13/96 04:45 PM
Time of Injection: 3/13/96 04:24 PM
Low Point : 36.92 mV
Plot Scale: 50 mV



High Point : 86.92 mV



TEH Chromatogram - GC 11 Ch B

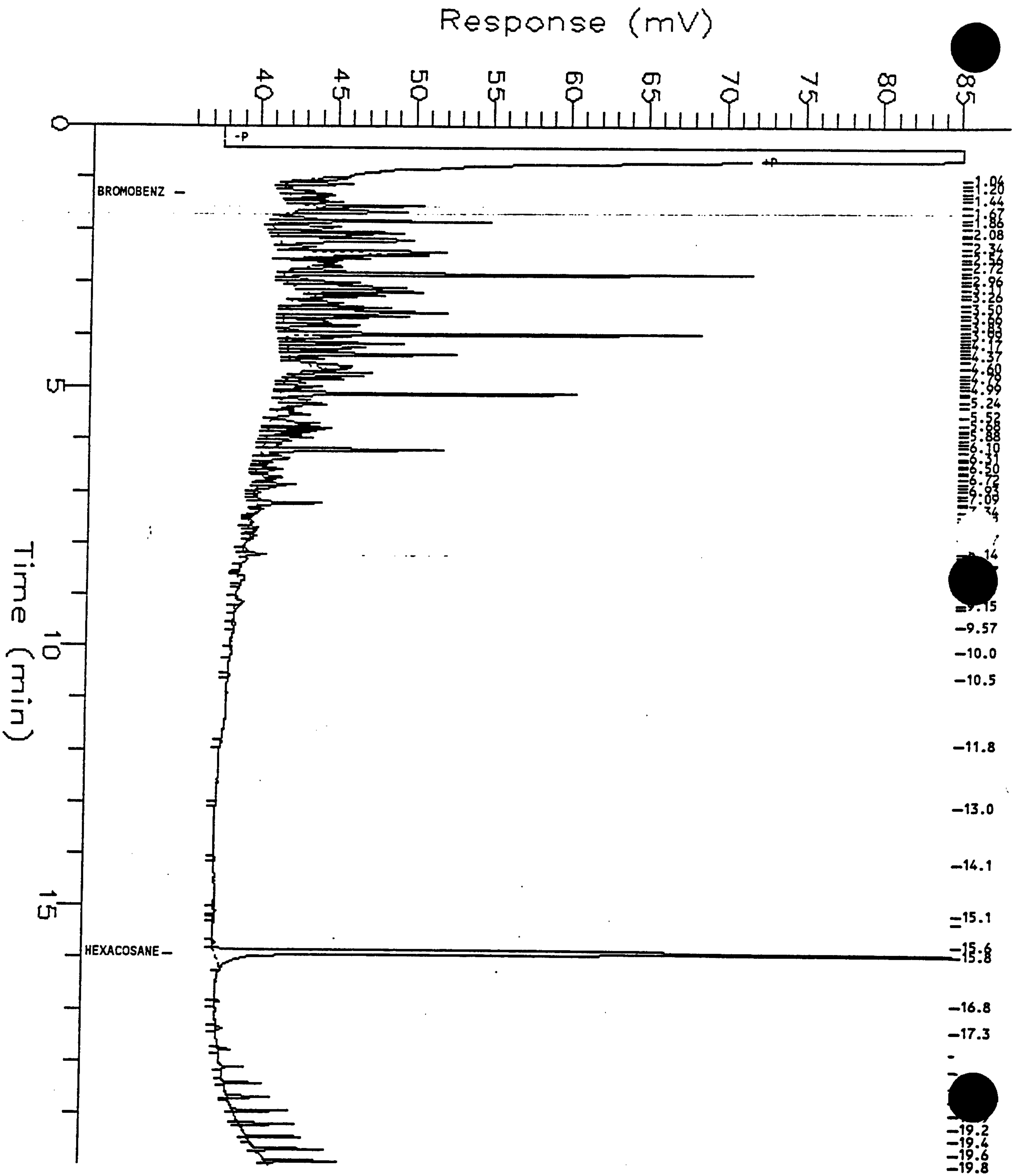
Sample Name : JP-5 250MG/L
FileName : g:\gc11\chb\073B015.raw
Method : 11B20.ins
Start Time : 0.00 min
Scale Factor: -1

End Time : 20.00 min
Plot Offset: 35 mV

Sample #: 96WS2068
Date : 3/13/96 05:15 PM
Time of Injection: 3/13/96 04:55 PM
Low Point : 35.11 mV
Plot Scale: 50 mV

Page 1 of 1

High Point : 85.11 mV

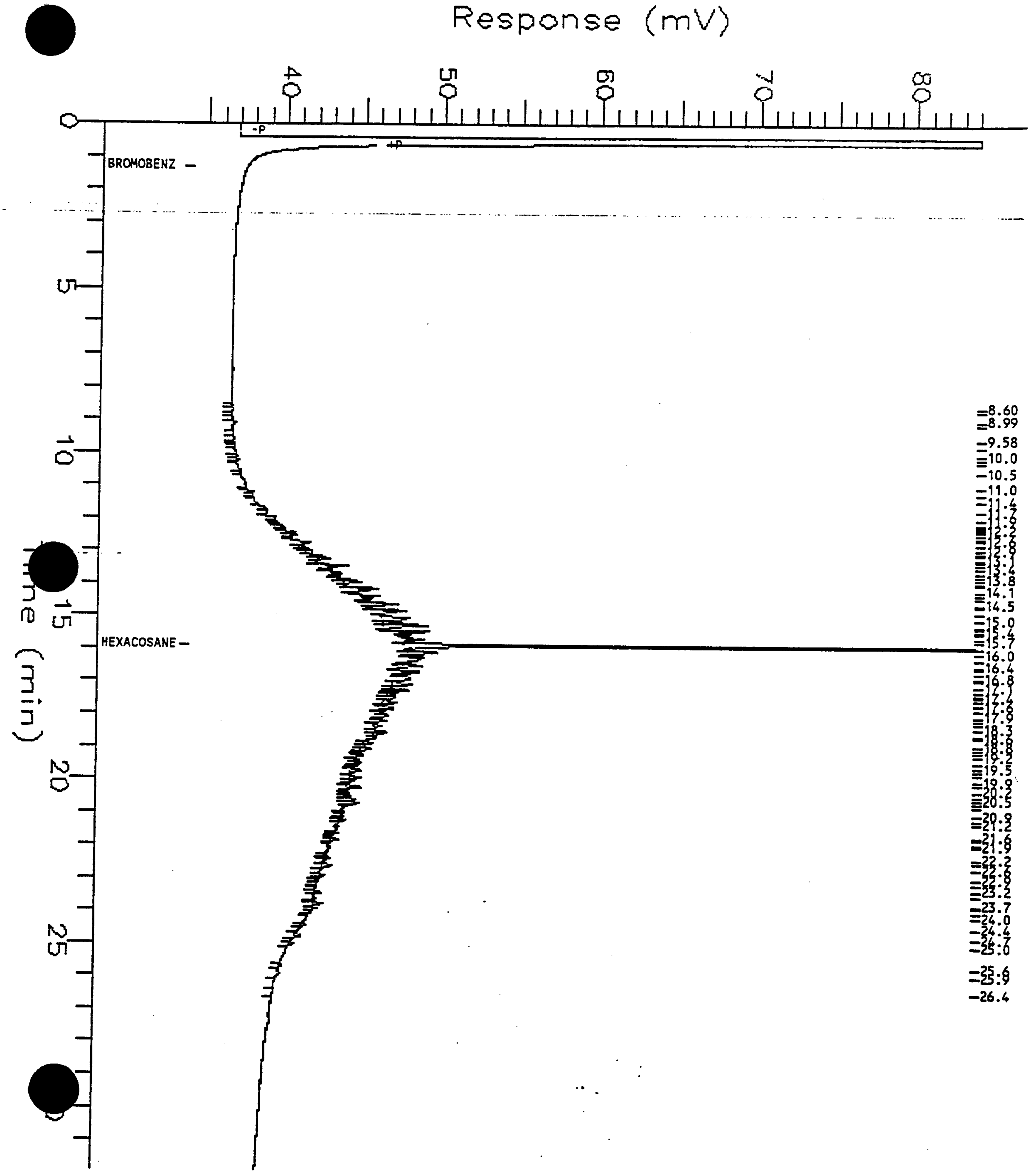


# TEH Chromatogram - GC 11 Ch B

Sample Name : MOTOR OIL 500MG/L
FileName : g:\gc11\chb\073B016.raw
Method : 11B32.ins
Start Time : 0.00 min
End Time : 31.92 min
Scale Factor: -1
Plot Offset: 34 mV

Sample #: 95WS1596
Date : 3/13/96 05:58 PM
Time of Injection: 3/13/96 05:25 PM
Low Point : 34.04 mV
High Point : 84.04 mV
Plot Scale: 50 mV





Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# A N A L Y T I C A L   R E P O R T

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 28-MAR-96
Lab Job Number: 124747
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Terra K Morris

Reviewed by: 

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Curtis & Tompkins, Ltd

**Laboratory Number: 124747**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 03/07,08/96**
**Receipt Date: 03/08/96**

## CASE NARRATIVE

Curtis & Tompkins,Ltd. received six water samples and one trip blank from the above referenced project on March 8, 1996. All samples were received cold and intact.

**TPH/Extractable:** No analytical problems were encountered.

**TPH/Gasoline:** The trip blank was not documented on the chain of custody. The sampling date on the trip blank label was 2/29/96. Analysis of this trip blank was not completed until 3/22/96, which is past the technical holding time. As BTXE and gasoline are analyzed concurrently, only one set of matrix spikes are performed. The matrix spikes associated with these samples were analyzed for BTXE. The gasoline laboratory control samples passed acceptance criteria.

**BTXE & TMBs:** The trip blank was not documented on the chain of custody. The sampling date on the trip blank label was 2/29/96. The analysis was not performed until 3/22/96, which is past the technical holding time.

**ES** ENGINEERING-SCIENCE COMPANIES

# MEMORANDUM TO FILE

JOB NO. 722450.14050

FILE DESIGNATION Beale AFB, UST Site

DATE 4/4/96 TIME

PHONE CALL FROM Michael Phelps PHONE NO.

PHONE CALL TO PHONE NO.

CONFERENCE WITH

PLACE

SUBJECT Trip Blanks, Data Packages 124746, 124747

The dates on the labels used for trip blanks submitted on the chain-of-custodies dated 3/7/96 and 3/8/96 were incorrect. They should have reflected the dates on the chain-of-custody. Therefore, the analyses of both trip blanks is within the analytical method hold time.

SIGNED [signature]

**PARSONS ENGINEERING SCIENCE, INC.**

1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

124747

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020

Project Name/Location: Beale AFB, UST Site

Project Manager: Todd Wiedemeier (Denver, CO)

Site Manager: Michael Phelps (Alameda, CA)

Sampler(s): (Initials and Signature(s))

Michael H. Friedman

ANALYTES (METHOD): ORGANICS / INORGANICS / OTHER

Note: All analyses and holding times according to AFCEE handbook requirements.

| | Sample ID | Date | Time | Begin Depth | End Depth | Matrix | NO. OF CONTAINERS | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see note 1 | BTEX and TMBs (5030/8020) see notes 1, 2 | Halogenated VOCs (5030/8010) see notes 1, 4 | SVOCs (3550/8270) see note 1 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BE-MP20-01 | 3/8/96 | 0920 | - | - | water | 4 | X | X | X | | | |
| 2 | BE-MW02-01 | 3/8/96 | 1115 | - | - | water | 4 | X | X | X | | | |
| 3 | BE-MP21-01 | 3/8/96 | 1320 | - | - | water | 4 | X | X | X | | | |
| 4 | BE-MW01-01 | 3/8/96 | 1430 | - | - | water | 4 | X | X | X | | | |
| 5 | BE-MW18-01 | 3/8/96 | 1500 | - | - | water | 4 | X | X | X | | | |
| 6 | BE-MW19-01 | 3/7/96 | 1345 | - | - | water | 3 | X | | X | | | |
| | | | | | | water | | | | | | | |
| * | Trip blank | | | | | water | | * | | * | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | * Run per M.P. 3/18 |

TEMP. RECEIVED:
RECEIVED BY:

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| | | | |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LAB BY: (SIGNATURE) | DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|---|---|---|---|
| | 3/8/96 | 1834 | D. Moore | 3/8/96 | 6:35 pm | |

NOTES:
1. Secondary column confirmation required.
2. Quantify all carbon ranges: diesel, jet fuel, oil/grease.
3. Deionized water extraction
4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

Beale

Curtis & Tompkins, Ltd.

# COOLER RECEIPT CHECKLIST

Login#: 124747 Date Received: 3/8 Number of Coolers: 1

Client: [illegible] Project: Beale

A. Preliminary Examination Phase

Date Opened: 3/8 By (print): [illegible] (sign) [illegible]

1. Did cooler come with a shipping slip (airbill, etc.)? .................... YES NO

If YES, enter carrier name and airbill number: —

2. Were custody seals on outside of cooler? .................... YES NO

How many and where? Seal date: Seal name: —

3. Were custody seals unbroken and intact at the date and time of arrival? .................... YES NO N/A

4. Were custody papers dry and intact when received? .................... YES NO

5. Were custody papers filled out properly (ink, signed, etc.)? .................... YES NO

6. Did you sign the custody papers in the appropriate place? .................... YES NO

7. Was project identifiable from custody papers? .................... YES NO

If YES, enter project name at the top of this form.

8. If required, was sufficient ice used? .................... YES NO

Type of ice: [illegible] Temperature: 5.0°C

B. Login Phase

Date Logged In: 3/11 By (print): [illegible] (sign) [illegible]

1. Describe type of packing in cooler: bubble wrap

2. Did all bottles arrive unbroken? .................... YES NO

3. Were labels in good condition and complete (ID, date, time, signature, etc.)? .................... YES NO

4. Did bottle labels agree with custody papers? .................... YES NO

5. Were appropriate containers used for the tests indicated? .................... YES NO

6. Were correct preservatives added to samples? .................... YES NO

7. Was sufficient amount of sample sent for tests indicated? .................... YES NO

8. Were bubbles absent in VOA samples? If NO, list sample Ids below .................... YES NO

9. Was the client contacted concerning this sample delivery? .................... YES NO

If YES, give details below.

Who was called? By whom? Date:

Additional Comments:

Trip blank not on C-O-C

logged on hold [illegible] 3/11/[illegible]

# CURTIS & TOMPKINS, LTD. BERKELEY LOGIN CHANGE FORM

Reason for change: ✓ Client Request: By: M. Phelps Date/Time: 3/18/96 Initials: ______

______ Login Review ______ Data Review

| Current Lab ID | Previous Lab ID | Client ID | Matrix | Add/Cancel | Analysis | Duedate |
|---|---|---|---|---|---|---|
| 124747-7 | | TRIP BLANK | $H_2O$ | Add | TVH/B/~~MTB~~ TMB | 3/25 |

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## TEH-Tot Ext Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 3520 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124747-001 | BE-MP20-01 | 26390 | 03/08/96 | 03/12/96 | 03/14/96 | |
| 124747-002 | BE-MW02-01 | 26390 | 03/08/96 | 03/12/96 | 03/14/96 | |
| 124747-003 | BE-MP21-01 | 26390 | 03/08/96 | 03/12/96 | 03/14/96 | |
| 124747-004 | BE-MW01-01 | 26390 | 03/08/96 | 03/12/96 | 03/14/96 | |

| Analyte | Units | 124747-001 | 124747-002 | 124747-003 | 124747-004 |
|---|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | 1 | 1 |
| JP5 | ug/L | <50 | <50 | <50 | <50 |
| Diesel Range | ug/L | <50 | <50 | <50 | <50 |
| Motor Oil Range | ug/L | <300 | <300 | <300 | <300 |
| **Surrogate** | | | | | |
| Hexacosane | %REC | 69 | 76 | 76 | 72 |

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TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 3520

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124747-005 | BE-MW18-01 | 26390 | 03/07/96 | 03/12/96 | 03/14/96 | |

| Analyte<br>Diln Fac: | Units | 124747-005<br>1 |
|---|---|---|
| JP5 | ug/L | <50 |
| Diesel Range | ug/L | <50 |
| Motor Oil Range | ug/L | <300 |
| Surrogate | | |
| Hexacosane | %REC | 73 |

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**TEH-Tot Ext Hydrocarbons**

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 3520 |
| Location: Beale AFB | |

**METHOD BLANK**

| | |
|---|---|
| Matrix: Water | Prep Date: 03/12/96 |
| Batch#: 26390 | Analysis Date: 03/14/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC16985

| Analyte | Result | |
|---|---|---|
| JP5 | <50 | |
| Diesel Range | <50 | |
| Motor Oil Range | <300 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 69 | 60-140 |

Curtis & Tompkins, Ltd



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 3520

## BLANK SPIKE/BLANK SPIKE DUPLICATE

Matrix: Water
Batch#: 26390
Units: ug/L
Diln Fac: 1

Prep Date: 03/12/96
Analysis Date: 03/13/96

BS Lab ID: QC16986

| Analyte | Spike Added | BS | %Rec | # | Limits |
|---|---|---|---|---|---|
| Diesel Range | 2475 | 2143 | 87 | | 60-140 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 65 | 60-140 |

BSD Lab ID: QC16987

| Analyte | Spike Added | BSD | %Rec | # | Limits | RPD | # | Limit |
|---|---|---|---|---|---|---|---|---|
| Diesel Range | 2475 | 2278 | 92 | | 60-140 | 6 | | <35 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 68 | 60-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

Curtis & Tompkins, Ltd



## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124747-001 | BE-MP20-01 | 26544 | 03/08/96 | 03/22/96 | 03/22/96 | |
| 124747-002 | BE-MW02-01 | 26544 | 03/08/96 | 03/22/96 | 03/22/96 | |
| 124747-003 | BE-MP21-01 | 26544 | 03/08/96 | 03/22/96 | 03/22/96 | |
| 124747-004 | BE-MW01-01 | 26544 | 03/08/96 | 03/22/96 | 03/22/96 | |

| Analyte<br>Diln Fac: | Units | 124747-001<br>1 | 124747-002<br>1 | 124747-003<br>1 | 124747-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | ug/L | <50 | <50 | <50 | <50 |
| Surrogate | | | | | |
| Trifluorotoluene | %REC | 100 | 101 | 100 | 100 |
| romobenzene | %REC | 94 | 95 | 95 | 95 |

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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124747-005 | BE-MW18-01 | 26544 | 03/07/96 | 03/22/96 | 03/22/96 | |
| 124747-006 | BE-MW19-01 | 26544 | 03/07/96 | 03/22/96 | 03/22/96 | |
| 124747-007 | TRIP BLANK | 26573 | 02/29/96 | 03/22/96 | 03/22/96 | |

| Analyte<br>Diln Fac: | Units | 124747-005<br>1 | 124747-006<br>1 | 124747-007<br>1 |
|---|---|---|---|---|
| Gasoline | ug/L | <50 | <50 | <50 |
| Surrogate | | | | |
| Trifluorotoluene | %REC | 101 | 102 | 99 |
| Bromobenzene | %REC | 95 | 99 | 95 |

Curtis & Tompkins, Ltd

Lab #: 124747

# BATCH QC REPORT



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/21/96 |
| Batch#: 26544 | Analysis Date: 03/21/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC17561

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 98 | 69-120 |
| Bromobenzene | 89 | 70-122 |

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| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: CA LUFT (EPA 8015M)<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Water<br>Batch#: 26573<br>Units: ug/L<br>Diln Fac: 1 | Prep Date: 03/22/96<br>Analysis Date: 03/22/96 |

MB Lab ID: QC17665

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 98 | 69-120 |
| Bromobenzene | 91 | 70-122 |

Curtis & Tompkins, Ltd

Lab #: 124747

BATCH QC REPORT



TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26544
Units: ug/L
Diln Fac: 1

Prep Date: 03/21/96
Analysis Date: 03/21/96

LCS Lab ID: QC17562

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 2008 | 2000 | 100 | 80-120 |
| **Surrogate** | **%Rec** | **Limits** | | |
| Trifluorotoluene | 104 | 69-120 | | |
| Bromobenzene | 111 | 70-122 | | |

\# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
pike Recovery: 0 out of 1 outside limits

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BATCH QC REPORT



TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Prep Date: 03/22/96
Analysis Date: 03/22/96

LCS Lab ID: QC17666

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 2008 | 2006 | 100 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 106 | 69-120 |
| Bromobenzene | 112 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124747-001 | BE-MP20-01 | 26544 | 03/08/96 | 03/22/96 | 03/22/96 | |
| 124747-002 | BE-MW02-01 | 26544 | 03/08/96 | 03/22/96 | 03/22/96 | |
| 124747-003 | BE-MP21-01 | 26544 | 03/08/96 | 03/22/96 | 03/22/96 | |
| 124747-004 | BE-MW01-01 | 26544 | 03/08/96 | 03/22/96 | 03/22/96 | |

| Analyte<br>Diln Fac: | Units | 124747-001<br>1 | 124747-002<br>1 | 124747-003<br>1 | 124747-004<br>1 |
|---|---|---|---|---|---|
| Benzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| Ethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 99 | 97 | 98 | 97 |
| Bromobenzene | %REC | 94 | 95 | 95 | 95 |

## BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124747-005 | BE-MW18-01 | 26544 | 03/07/96 | 03/22/96 | 03/22/96 | |
| 124747-006 | BE-MW19-01 | 26544 | 03/07/96 | 03/22/96 | 03/22/96 | |
| 124747-007 | TRIP BLANK | 26573 | 02/29/96 | 03/22/96 | 03/22/96 | |

| Analyte<br>Diln Fac: | Units | 124747-005<br>1 | 124747-006<br>1 | 124747-007<br>1 |
|---|---|---|---|---|
| Benzene | ug/L | <0.5 | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | 0.6 | <0.5 |
| Ethylbenzene | ug/L | <0.5 | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 |
| **Surrogate** | | | | |
| Trifluorotoluene | %REC | 98 | 98 | 100 |
| Bromobenzene | %REC | 96 | 97 | 91 |

Curtis & Tompkins, Ltd

Lab #: 124747

BATCH QC REPORT



BTXE

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

METHOD BLANK

| | | | |
|---|---|---|---|
| Matrix: | Water | Prep Date: | 03/21/96 |
| Batch#: | 26544 | Analysis Date: | 03/21/96 |
| Units: | ug/L | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC17561

| Analyte | Result |
|---|---|
| Benzene | <0.5 |
| Toluene | <0.5 |
| Ethylbenzene | <0.5 |
| m,p-Xylenes | <0.5 |
| o-Xylene | <0.5 |
| 1,2,3-Trimethylbenzene | <0.5 |
| 1,2,4-Trimethylbenzene | <0.5 |
| 1,3,5-Trimethylbenzene | <0.5 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| Trifluorotoluene | 96 | 58-130 |
| Bromobenzene | 91 | 62-131 |

Curtis & Tompkins, Ltd

Lab #: 124747

BATCH QC REPORT



BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/22/96 |
| Batch#: 26573 | Analysis Date: 03/22/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC17665

| Analyte | Result | |
|---|---|---|
| Benzene | <0.5 | |
| Toluene | <0.5 | |
| Ethylbenzene | <0.5 | |
| m,p-Xylenes | <0.5 | |
| o-Xylene | <0.5 | |
| 1,2,3-Trimethylbenzene | <0.5 | |
| 1,2,4-Trimethylbenzene | <0.5 | |
| 1,3,5-Trimethylbenzene | <0.5 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 80 | 58-130 |
| Bromobenzene | 88 | 62-131 |

Curtis & Tompkins, Ltd

Lab #: 124747

BATCH QC REPORT



BTXE

lient: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26544
Units: ug/L
Diln Fac: 1

Prep Date: 03/21/96
Analysis Date: 03/21/96

LCS Lab ID: QC17563

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 18.5 | 20 | 93 | 80-120 |
| Toluene | 18.5 | 20 | 93 | 80-120 |
| Ethylbenzene | 18.1 | 20 | 91 | 80-120 |
| m,p-Xylenes | 36.5 | 40 | 91 | 80-120 |
| o-Xylene | 18.4 | 20 | 92 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 97 | 58-130 |
| Bromobenzene | 91 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
lues outside of QC limits
e Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd



BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Water | Prep Date: 03/22/96 |
| Batch#: 26573 | Analysis Date: 03/22/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

LCS Lab ID: QC17667

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 18.5 | 20 | 93 | 80-120 |
| Toluene | 18.4 | 20 | 92 | 80-120 |
| Ethylbenzene | 18 | 20 | 90 | 80-120 |
| m,p-Xylenes | 36.6 | 40 | 92 | 80-120 |
| o-Xylene | 18.5 | 20 | 93 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 100 | 58-130 |
| Bromobenzene | 90 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd

Lab #: 124747

BATCH QC REPORT



BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124881-001
Matrix: Water
Batch#: 26544
Units: ug/L
Diln Fac: 1

Sample Date: 03/19/96
Received Date: 03/19/96
Prep Date: 03/21/96
Analysis Date: 03/21/96

MS Lab ID: QC17564

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Benzene | 20 | <0.5000 | 18.6 | 93 | 75-125 |
| Toluene | 20 | <0.5000 | 18.9 | 95 | 75-125 |
| Ethylbenzene | 20 | <0.5000 | 18.4 | 92 | 75-125 |
| m,p-Xylenes | 40 | <0.5000 | 37 | 93 | 75-125 |
| o-Xylene | 20 | <0.5000 | 18.8 | 94 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 96 | 58-130 |
| Bromobenzene | 90 | 62-131 |

MSD Lab ID: QC17565

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Benzene | 20 | 19.2 | 96 | 75-125 | 3 | <20 |
| Toluene | 20 | 19.6 | 98 | 75-125 | 4 | <20 |
| Ethylbenzene | 20 | 19.2 | 96 | 75-125 | 4 | <20 |
| m,p-Xylenes | 40 | 38.3 | 96 | 75-125 | 4 | <20 |
| o-Xylene | 20 | 19.6 | 98 | 75-125 | 4 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 97 | 58-130 |
| Bromobenzene | 94 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

Curtis & Tompkins, Ltd

Lab #: 124747

BATCH QC REPORT



BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124900-009
Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Sample Date: 03/19/96
Received Date: 03/20/96
Prep Date: 03/22/96
Analysis Date: 03/22/96

MS Lab ID: QC17668

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Benzene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| Toluene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| Ethylbenzene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| m,p-Xylenes | 40 | <0.5000 | 38.1 | 95 | 75-125 |
| o-Xylene | 20 | <0.5000 | 19.4 | 97 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 101 | 58-130 |
| Bromobenzene | 91 | 62-131 |

MSD Lab ID: QC17669

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Benzene | 20 | 19.8 | 99 | 75-125 | 4 | <20 |
| Toluene | 20 | 19.7 | 99 | 75-125 | 3 | <20 |
| Ethylbenzene | 20 | 19.5 | 98 | 75-125 | 2 | <20 |
| m,p-Xylenes | 40 | 39 | 98 | 75-125 | 2 | <20 |
| o-Xylene | 20 | 19.8 | 99 | 75-125 | 2 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 101 | 58-130 |
| Bromobenzene | 94 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# ANALYTICAL REPORT

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 28-MAR-96
Lab Job Number: 124796
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Teresa K Morris

Reviewed by:

Curtis & Tompkins, Ltd

Laboratory Number: 124796
Client: Parsons Engineering Science
Project#: 722450.14020
Location: Beale AFB

Sample Date: 03/11,12/96
Receipt Date:03/13/96

## CASE NARRATIVE

Curtis & Tompkins received six water samples from the above referenced project on March 13, 1996. The chain of custody incorrectly indicated that all samples were soil. No amber liter was received for sample BE-MP15-01. The project manager was notified of these discrepancies on March 13, 1996.

**TPH/Extractable:** The sample chromatogram is included in this report for sample BE-MP22-01 (C&T# 124796-004), along with example chromatograms for JP-5 and diesel. No analytical problems were encountered.

**TPH/Gasoline:** Sample chromatograms are included for any sample containing quantifiable concentrations of purgeable hydrocarbons, along with an example gasoline standard. The patterns exhibited in these sample chromatograms do not resemble gasoline, but are similar to JP-4.

**BTXE (EPA 8020):** The "C" qualifier flag indicates that the target compound reported was confirmed by a second analytical column, but that the concentration quantitated on the second column differed from the reported concentration by more than a factor of two. This often happens when the fuel pattern present in the samples does not resemble gasoline.

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## TEH-Tot Ext Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 3520 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124796-002 | BE-MP17-01 | 26473 | 03/11/96 | 03/18/96 | 03/21/96 | |
| 124796-004 | BE-MP22-01 | 26473 | 03/12/96 | 03/18/96 | 03/21/96 | |

| Analyte | Units | 124796-002 | 124796-004 | |
|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | |
| JP5 | ug/L | <50 | 340 | Y |
| Diesel Range | ug/L | <50 | 320 | Y |
| Motor Oil Range | ug/L | <300 | <300 | |
| Surrogate | | | | |
| Hexacosane | %REC | 103 | 95 | |

Sample exhibits fuel pattern which does not resemble standard

## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 3520

## METHOD BLANK

Matrix: Water
Batch#: 26473
Units: ug/L
Diln Fac: 1

Prep Date: 03/18/96
Analysis Date: 03/21/96

MB Lab ID: QC17319

| Analyte | Result |
|---|---|
| JP5 | <50 |
| Diesel Range | <50 |
| Motor Oil Range | <300 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| Hexacosane | 108 | 60-140 |

Curtis & Tompkins, Ltd.

Lab #: 124796

# BATCH QC REPORT



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 3520

## BLANK SPIKE/BLANK SPIKE DUPLICATE

Matrix: Water
Batch#: 26473
Units: ug/L
Diln Fac: 1

Prep Date: 03/18/96
Analysis Date: 03/19/96

BS Lab ID: QC17320

| Analyte | Spike Added | BS | %Rec | # | Limits |
|---|---|---|---|---|---|
| Diesel Range | 2475 | 2203 | 89 | | 60-140 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 95 | 60-140 |

BSD Lab ID: QC17321

| Analyte | Spike Added | BSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Diesel Range | 2475 | 2640 | 107 | 60-140 | 18 | <35 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 93 | 60-140 |

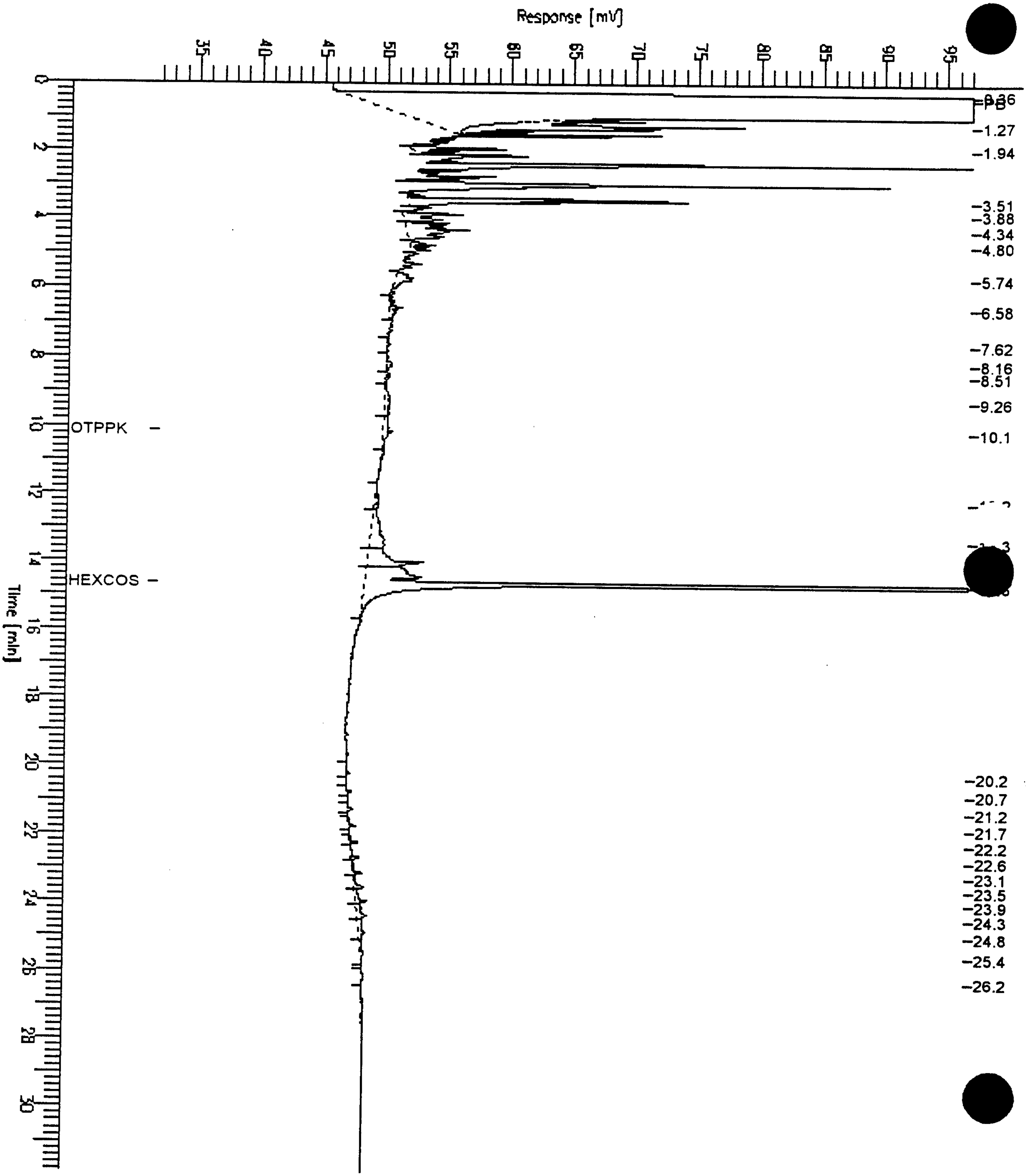
# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

# GC15 Channel A Surrogate

Sample Name : S,124796-004,26473
FileName : C:\GC15\CHB\080B017.raw
Method : DUAL
Start Time : 0.00 min
End Time : 31.90 min
Scale Factor: 0.0
Plot Offset: 32 mV

Sample #: 500:2.5
Date : 3/21/96 04:23 AM
Time of Injection: 3/21/96 03:50 AM
Low Point : 32.00 mV
High Point : 97.00 mV
Plot Scale: 65.0 mV





JP-5

# GC15 Channel A Surrogate

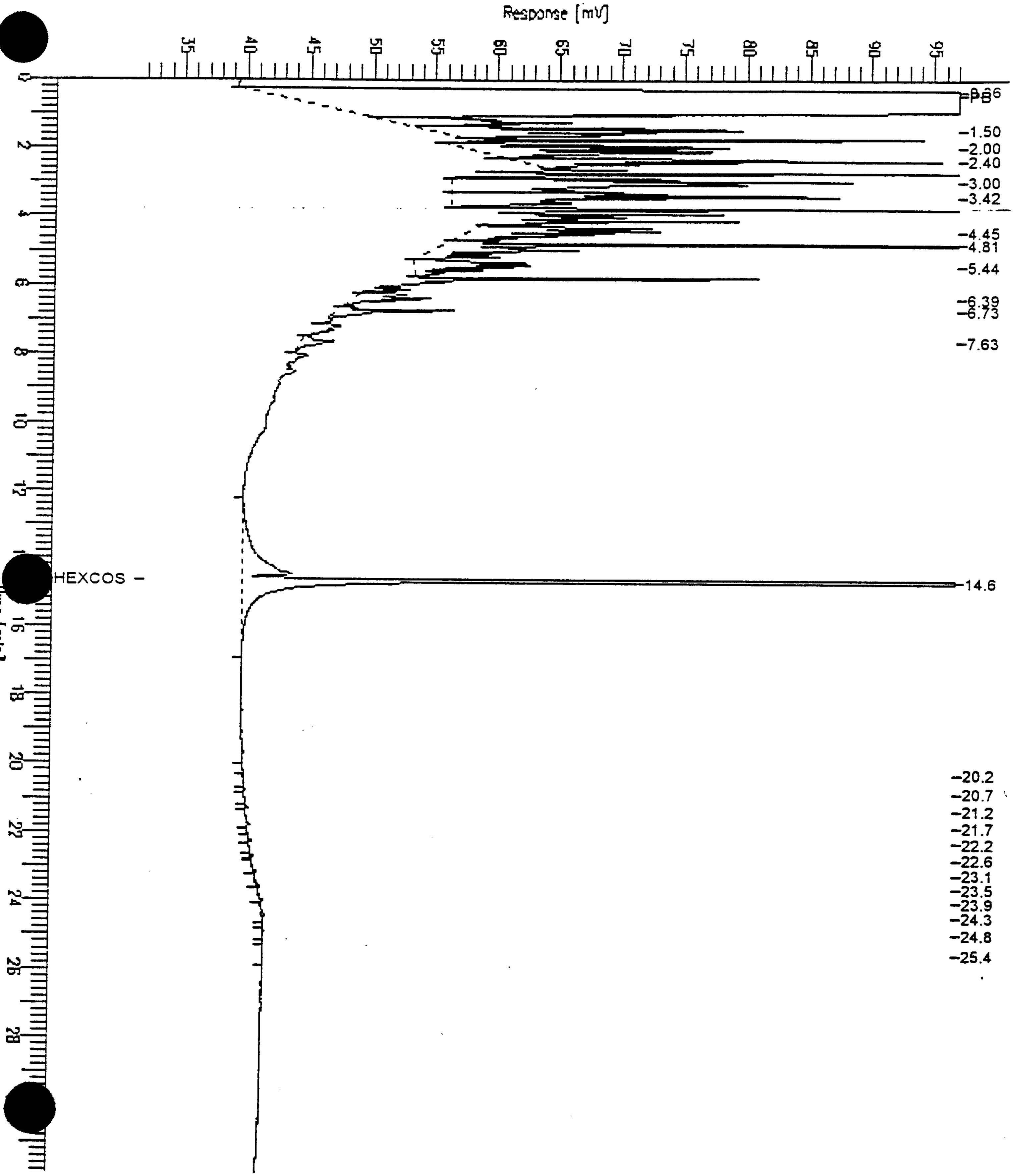
Sample Name : CCV,96WS2068,JP5
FileName : C:\GC15\CHB\090B004.raw
Method : DUAL
Start Time : 0.00 min
Scale Factor: 0.0

End Time : 31.90 min
Plot Offset: 32 mV

Sample #: 250MG/L
Date : 3/20/96 06:58 PM
Time of Injection: 3/20/96 06:19 PM
Low Point : 32.00 mV
Plot Scale: 65.0 mV

Page 1 of 1

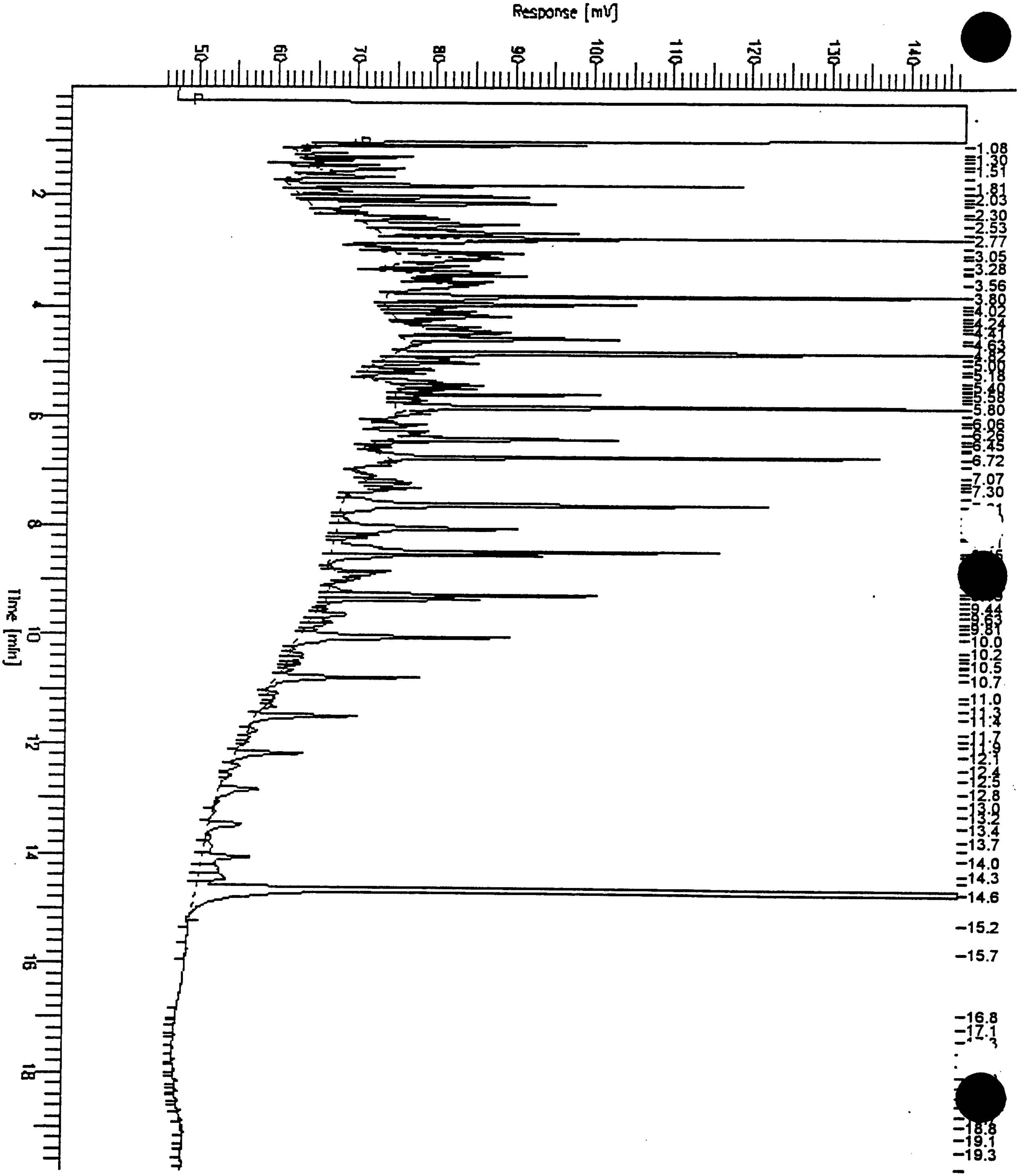
High Point : 97.00 mV



Diesel

GC15 Channel A TEH

Sample Name : CCV,96WS1948,DSL
FileName : C:\GC15\CHB\079B024.RAW
Method : BTEH.MTH
Start Time : 0.01 min
End Time : 19.80 min
Scale Factor: 0.0
Plot Offset: 45 mV
Sample #: 500MG/L
Page 1 of 1
Date : 3/20/96 11:00 AM
Time of Injection: 3/20/96 12:52 AM
Low Point : 45.37 mV
High Point : 146.83 mV
Plot Scale: 101.5 mV



Curtis & Tompkins, Ltd



## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124796-001 | BE-MP15-01 | 26573 | 03/11/96 | 03/23/96 | 03/23/96 | |
| 124796-002 | BE-MP17-01 | 26573 | 03/11/96 | 03/22/96 | 03/22/96 | |
| 124796-003 | BE-MP40-01 | 26573 | 03/11/96 | 03/23/96 | 03/23/96 | |
| 124796-004 | BE-MP22-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |

| Analyte<br>Diln Fac: | Units | 124796-001<br>1 | 124796-002<br>1 | 124796-003<br>1 | 124796-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | ug/L | 130 Y | <50 | <50 | 770 Y |
| Surrogate | | | | | |
| Trifluorotoluene | %REC | 100 | 100 | 87 | 101 |
| Bromobenzene | %REC | 97 | 97 | 83 | 106 |

Y = Sample exhibits fuel pattern which does not resemble standard

## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124796-005 | BE-MP42-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |
| 124796-006 | BE-MP43-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |

| Analyte<br>Diln Fac: | Units | 124796-005<br>1 | 124796-006<br>1 |
|---|---|---|---|
| Gasoline | ug/L | 790 Y | <50 |
| Surrogate | | | |
| Trifluorotoluene | %REC | 101 | 85 |
| Bromobenzene | %REC | 105 | 81 |

Y: Sample exhibits fuel pattern which does not resemble standard

Curtis & Tompkins, Ltd



| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| METHOD BLANK | |
|---|---|
| Matrix: Water | Prep Date: 03/22/96 |
| Batch#: 26573 | Analysis Date: 03/22/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC17665

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 98 | 69-120 |
| Bromobenzene | 91 | 70-122 |

Curtis & Tompkins, Ltd.



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Water | Prep Date: 03/22/96 |
| Batch#: 26573 | Analysis Date: 03/22/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

LCS Lab ID: QC17666

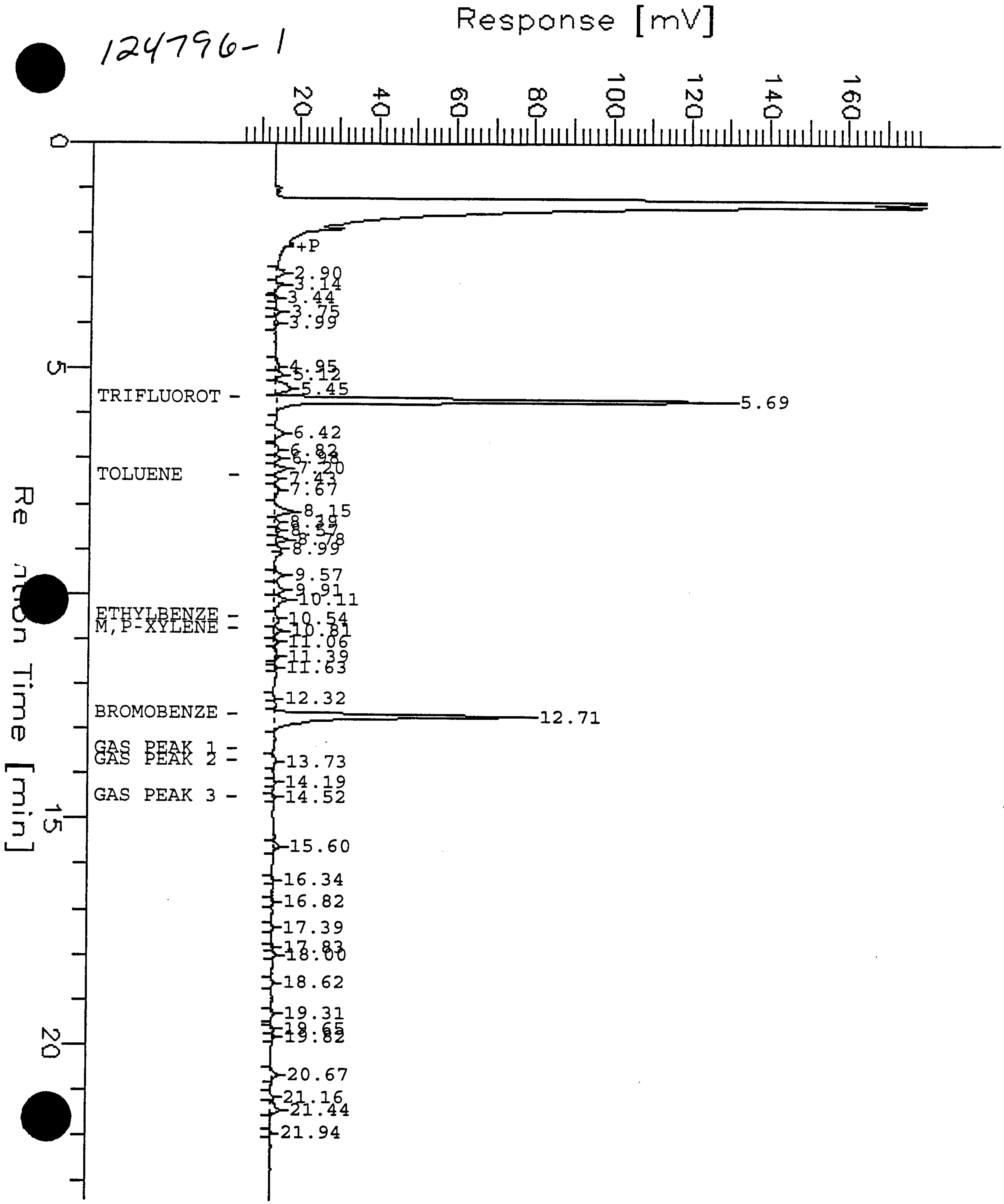
| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 2008 | 2006 | 100 | 80-120 |
| **Surrogate** | **%Rec** | **Limits** | | |
| Trifluorotoluene | 106 | 69-120 | | |
| Bromobenzene | 112 | 70-122 | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

TVH2 - GC-05 RTX-1

FileName : G:\GC05\082H033.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 23.42 min
Plot Offset: 5 mV
Date : 3/23/96 9:35 AM
Low Point : 4.82 mV
Plot Scale: 175 mV
Page 1 of 1
High Point : 179.82 mV

124796-1



FileName : G:\GC05\082H020.raw
Start Time : 0.00 min
Scale Factor: -1

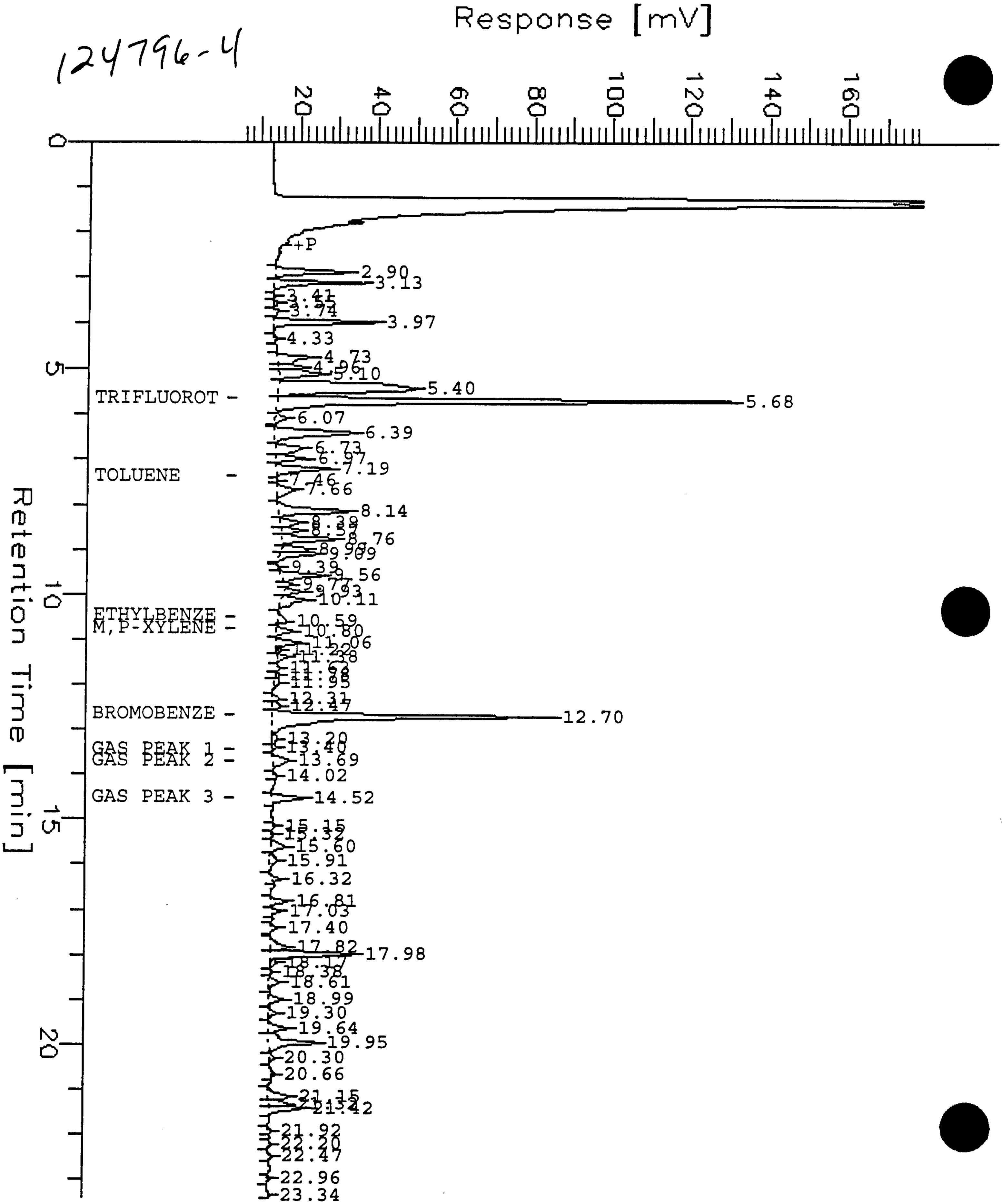
End Time : 23.42 min
Plot Offset: 4 mV

Date : 3/23/96 1:29 AM
Low Point : 4.20 mV
Plot Scale: 175 mV



High Point : 179.20 mV

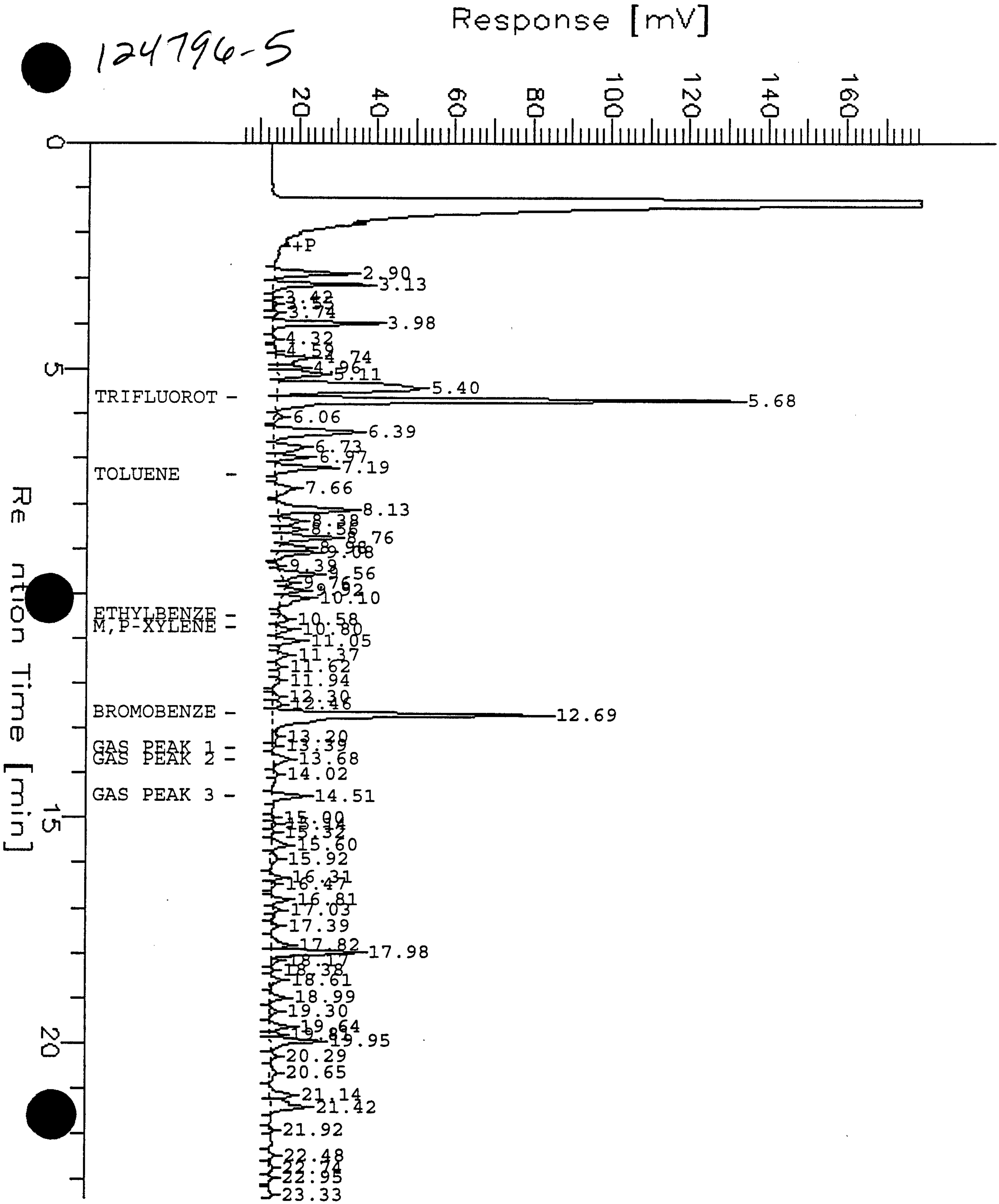
124796-4



FileName : G:\GC05\082H021.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 23.42 min
Plot Offset: 4 mV
Date : 3/23/96 2:06 AM
Low Point : 4.16 mV
Plot Scale: 175 mV

High Point : 179.16 mV

124796-5



C+T Gasoline Std.

TVH2 - GC-04 RTX-1

FileName : G:\GC04\135J001.raw
Start Time : 0.00 min
Scale Factor: -1

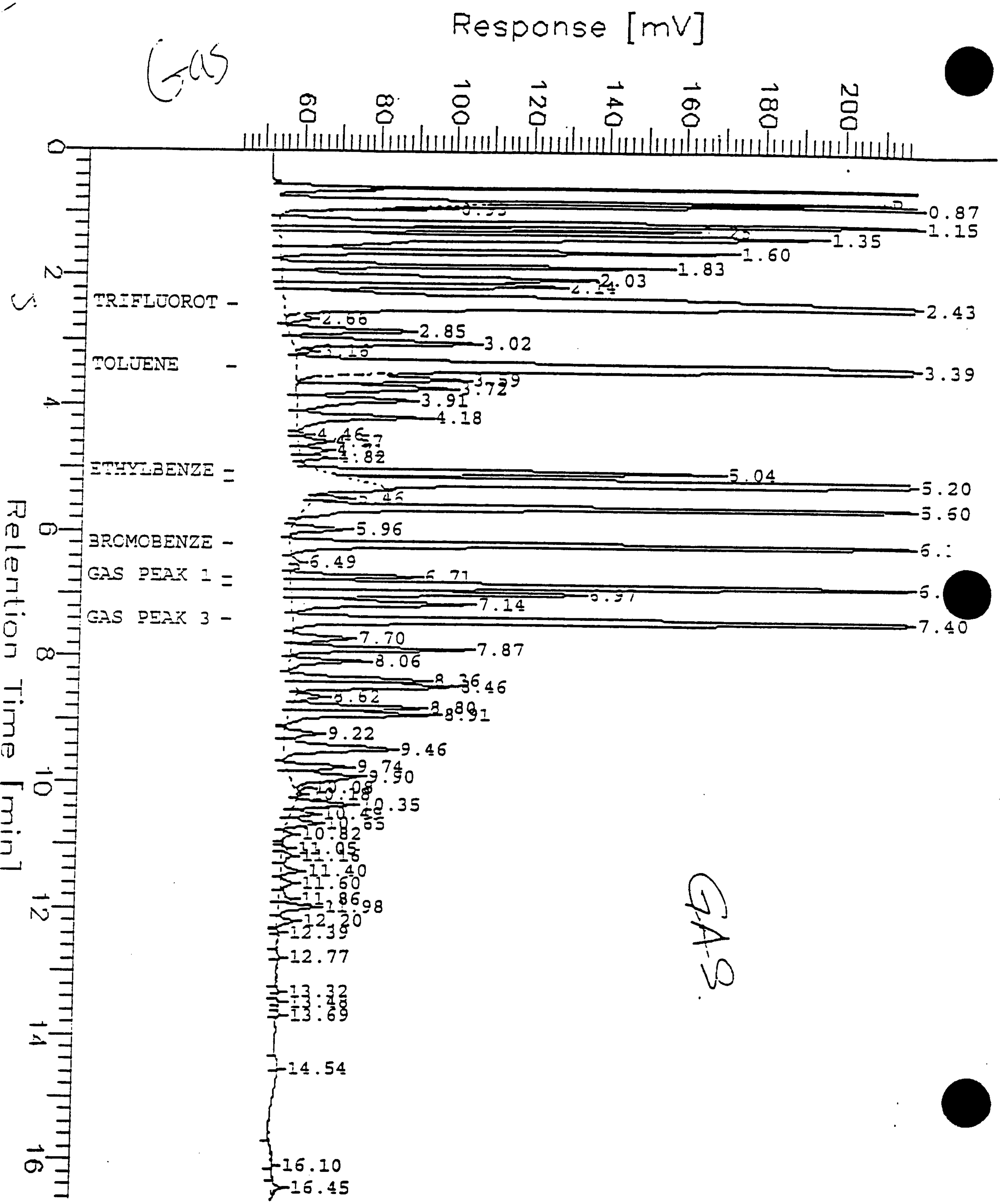
End Time : 17.00 min
Plot Offset: 43 mV

Date : 5/15/95 9:53 AM
Low Point : 42.92 mV
Plot Scale: 175 mV



High Point : 217.92 mV

GAS




GAS

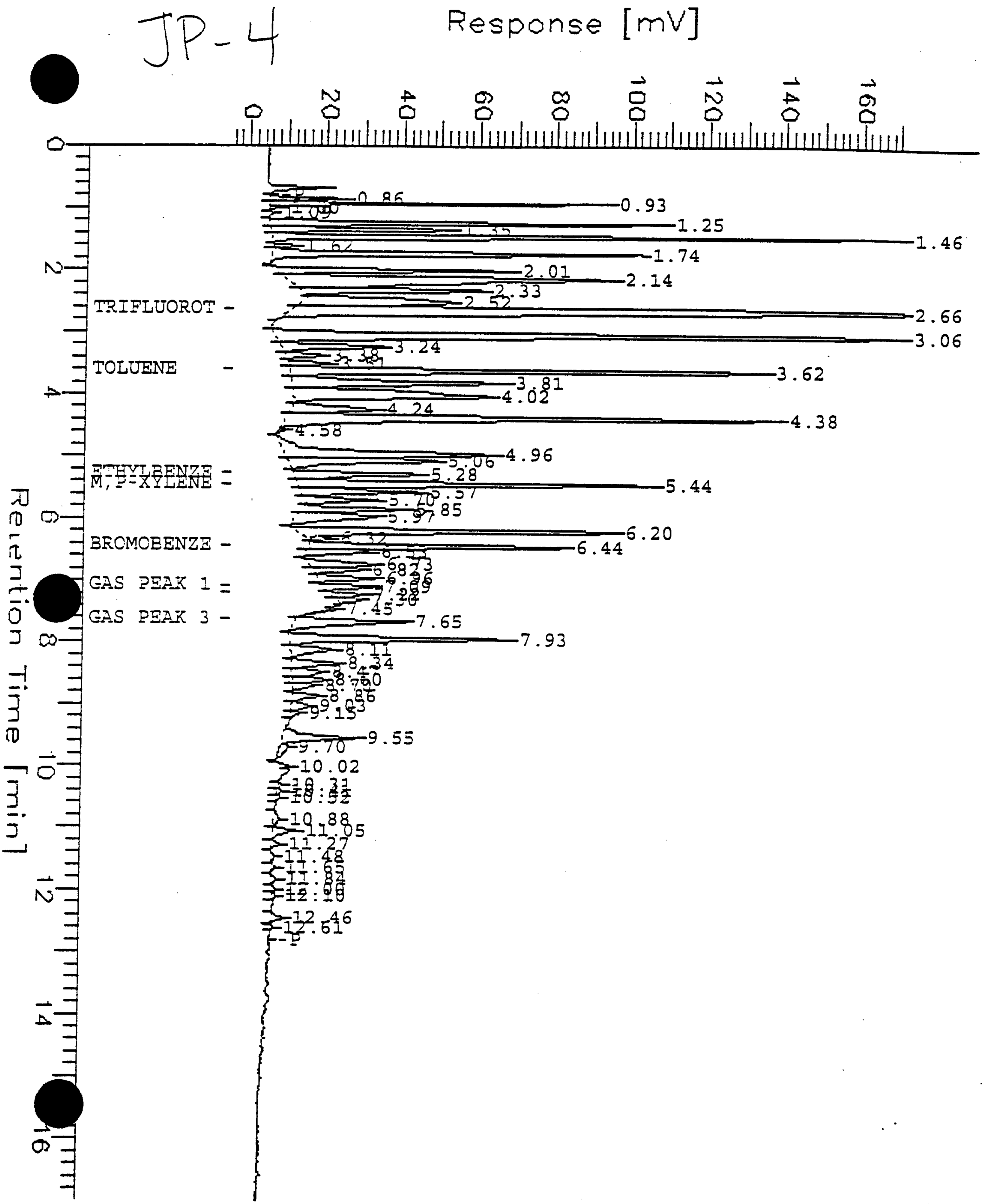
FileName : G:\GC04\B\026J011.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 17.00 min
Plot Offset: -4 mV

Date : 2/1/95 3:57 PM
Low Point : -4.15 mV
Plot Scale: 175 mV


High Point : 170.85 mV

JP-4



# BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124796-001 | BE-MP15-01 | 26573 | 03/11/96 | 03/23/96 | 03/23/96 | |
| 124796-002 | BE-MP17-01 | 26573 | 03/11/96 | 03/22/96 | 03/22/96 | |
| 124796-003 | BE-MP40-01 | 26573 | 03/11/96 | 03/23/96 | 03/23/96 | |
| 124796-004 | BE-MP22-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |

| Analyte<br>Diln Fac: | Units | 124796-001<br>1 | 124796-002<br>1 | 124796-003<br>1 | 124796-004<br>1 |
|---|---|---|---|---|---|
| Benzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| Toluene | ug/L | 0.6 | <0.5 | <0.5 | <0.5 |
| Ethylbenzene | ug/L | 0.7 | <0.5 | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | 0.8 | <0.5 | <0.5 | 2.2C |
| o-Xylene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 99 | 98 | 86 | 100 |
| Bromobenzene | %REC | 90 | 90 | 76 | 95 |

C: Presence of this compound confirmed by second column, however, the confirmation concentration differed from the reported result by more than a factor of two

## BTXE

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124796-005 | BE-MP42-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |
| 124796-006 | BE-MP43-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |

| Analyte | Units | 124796-005 | 124796-006 |
|---|---|---|---|
| Diln Fac: | | 1 | 1 |
| Benzene | ug/L | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 |
| Ethylbenzene | ug/L | 1.8C | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | 2.2C | <0.5 |
| **Surrogate** | | | |
| Trifluorotoluene | %REC | 100 | 84 |
| Bromobenzene | %REC | 95 | 75 |

C: Presence of this compound confirmed by second column, however, the confirmation concentration differed from the reported result by more than a factor of two

Curtis & Tompkins, Ltd



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## METHOD BLANK

Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Prep Date: 03/22/96
Analysis Date: 03/22/96

MB Lab ID: QC17665

| Analyte | Result |
|---|---|
| Benzene | <0.5 |
| Toluene | <0.5 |
| Ethylbenzene | <0.5 |
| m,p-Xylenes | <0.5 |
| o-Xylene | <0.5 |
| 1,2,3-Trimethylbenzene | <0.5 |
| 1,2,4-Trimethylbenzene | <0.5 |
| 1,3,5-Trimethylbenzene | <0.5 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| Trifluorotoluene | 80 | 58-130 |
| Bromobenzene | 88 | 62-131 |

Curtis & Tompkins, Ltd

Lab #: 124796 BATCH QC REPORT 

**BTXE**

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

**LABORATORY CONTROL SAMPLE**

Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Prep Date: 03/22/96
Analysis Date: 03/22/96

LCS Lab ID: QC17667

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 18.5 | 20 | 93 | 80-120 |
| Toluene | 18.4 | 20 | 92 | 80-120 |
| Ethylbenzene | 18 | 20 | 90 | 80-120 |
| m,p-Xylenes | 36.6 | 40 | 92 | 80-120 |
| o-Xylene | 18.5 | 20 | 93 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 100 | 58-130 |
| Bromobenzene | 90 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd.

Lab #: 124796

BATCH QC REPORT



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124900-009
Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Sample Date: 03/19/96
Received Date: 03/20/96
Prep Date: 03/22/96
Analysis Date: 03/22/96

MS Lab ID: QC17668

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Benzene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| Toluene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| Ethylbenzene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| m,p-Xylenes | 40 | <0.5000 | 38.1 | 95 | 75-125 |
| o-Xylene | 20 | <0.5000 | 19.4 | 97 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 101 | 58-130 |
| Bromobenzene | 91 | 62-131 |

MSD Lab ID: QC17669

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Benzene | 20 | 19.8 | 99 | 75-125 | 4 | <20 |
| Toluene | 20 | 19.7 | 99 | 75-125 | 3 | <20 |
| Ethylbenzene | 20 | 19.5 | 98 | 75-125 | 2 | <20 |
| m,p-Xylenes | 40 | 39 | 98 | 75-125 | 2 | <20 |
| o-Xylene | 20 | 19.8 | 99 | 75-125 | 2 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 101 | 58-130 |
| Bromobenzene | 94 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

**PARSONS ENGINEERING SCIENCE, INC.**
1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

124796

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020
Project Name/Location: Beale AFB, UST Site
Project Manager: Todd Wiedemeier (Denver, CO)
Site Manager: Michael Phelps (Alameda, CA)
Sampler(s): (Initials and Signature(s))
MHA - [signature]
HAE - [signature]
TXT - [signature]

Note: All analyses and holding times according to AFCEE handbook requirements.

| | Sample ID | Date | Time | Begin Depth | End Depth | Matrix | NO. OF CONTAINERS | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see note 1 | Leachable TPH (DI-WET/8015m) notes 1, 2 | BTEX and TMBs (5030/8020) see notes 1,2,3 | Halogenated VOCs (5030/8010) see notes 1,4 | SVOCs (3550/8270) | TOC (9060) | TKN (E351.2) | Alkalinity (Std Meth 403) | Total Phosphorus (E365.3) | Total Iron (6010 trace) | pH (9045) | Moisture Content (ASTM D-2216) | Grain-size (ASTM D-422) | OTHER | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BE-MP15-01 | 3/11/96 | 1040 | — | — | soil | 4 | X | X | | X | | | | | | | | | | | | NO AMBER L |
| 2 | BE-MP17-01 | 3/11/96 | 1230 | — | — | soil | 4 | X | X | | X | | | | | | | | | | | | |
| 3 | BE-MP40-01 | 3/11/96 | 1045 | — | — | soil | 3 | X | | | Y | | | | | | | | | | | | |
| 4 | BE-MP22-01 | 3/12/96 | 1120 | — | — | soil | 4 | X | X | | X | | | | | | | | | | | | |
| 5 | BE-MP42-01 | 3/12/96 | 1130 | — | — | soil | 4 | X | ~~X~~ | | X | | | | | | | | | | | | |
| 6 | BE-MP43-01 | 3/12/96 | 1140 | — | — | soil | 3 | X | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | Temperature 4°C @ 3/13/96 |
| | | | | | | soil | | | | | | | | | | | | | | | | | |
| | | | | | | soil | | | | | | | | | | | | | | | | | |

All samples are water - [initials] 3/13

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| [signature] | 3/12/96 | 12:30 | [signature] 3/13/96 |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LAB BY: (SIGNATURE) | DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|---|---|---|---|
| | | | | | | |

NOTES:
1. Secondary column confirmation required.
2. Quantify all carbon ranges: diesel, jet fuel, oil/grease.
3. Deionized water extraction
4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples

# COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login#: 124796 Date Received: 3/13/96 Number of Coolers: 1
Client: Parsons Eng. Project: Beale

A. Preliminary Examination Phase
Date Opened: 3/13/96 By (print): Cynthia Schl (sign) Cynthia E. Schlag

1. Did cooler come with a shipping slip (airbill, etc.)?............ 115469253 YES NO
If YES, enter carrier name and airbill number: FEDEX
2. Were custody seals on outside of cooler?............ YES NO
How many and where? 1 Seal date: Seal name:
3. Were custody seals unbroken and intact at the date and time of arrival?........... YES NO
4. Were custody papers dry and intact when received?............ YES NO
5. Were custody papers filled out properly (ink, signed, etc.)?............ YES NO
6. Did you sign the custody papers in the appropriate place?............ YES NO
7. Was project identifiable from custody papers?............ YES NO
If YES, enter project name at the top of this form.
8. If required, was sufficient ice used?............ YES NO
Type of ice: real Temperature: 4°C

B. Login Phase
Date Logged In: 3/13/96 By (print): Cynthia Schlg (sign) Cynthia Schlag

1. Describe type of packing in cooler: paper & bubble wrap
2. Did all bottles arrive unbroken?............ YES NO
3. Were labels in good condition and complete (ID, date, time, signature, etc.)?... YES NO
4. Did bottle labels agree with custody papers?............ YES NO MP15 amb. 1L
5. Were appropriate containers used for the tests indicated?............ YES NO
6. Were correct preservatives added to samples?............ YES NO
7. Was sufficient amount of sample sent for tests indicated?............ YES NO
8. Were bubbles absent in VOA samples? If NO, list sample Ids below............ YES NO
9. Was the client contacted concerning this sample delivery?............ YES NO
If YES, give details below.
Who was called? M. Phelps By whom? TKm Date: 3/13/96

Additional Comments:

BE-MP15-01 did have a amber 1L
Michael Phelps informed 3/13/96. TKm

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# ANALYTICAL REPORT

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 02-APR-96
Lab Job Number: 124797
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Julie K Morrison

Reviewed by:

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ES ENGINEERING-SCIENCE COMPANIES

MEMORANDUM TO FILE

JOB NO. 722450.14020

FILE DESIGNATION Beale AFB - UST Site

DATE 4/5/96 TIME

PHONE CALL FROM Michael Phelps PHONE NO.

PHONE CALL TO PHONE NO.

CONFERENCE WITH

PLACE

SUBJECT Incorrect sample designation on COC dated 3/12/96

The sample designated BE-MPØ8-Ø1 should have been designated BE-MPØ9-01. There was no sample collected from MP-Ø8.

SIGNED [signature]

Curtis & Tompkins, Ltd

**Laboratory Number: 124797**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 03/12/96**
**Receipt Date:03/13/96**

## CASE NARRATIVE

This hardcopy data package contains sample results and batch QC for six water samples received from the above referenced project on March 13, 1996. All samples were received cold and intact.

**TPH/Extractable:** No analytical problems were encountered.

**TPH/Purgeable:** Due to analyst oversight, sample BE-MP46-01 (C&T# 124797-006) was not analyzed until one day past the technical holding time. Sample chromatograms do not resemble gasoline, but are similar to JP-4.

**BTXE (EPA 8020):** Due to analyst oversight, sample BE-MP46-01 (C&T# 124797-006) was not analyzed until one day past the technical holding time.

Curtis & Tompkins, Ltd.



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 3520

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124797-001 | BE-MP11-01 | 26513 | 03/12/96 | 03/19/96 | 03/22/96 | |
| 124797-002 | BE-MP44-01 | 26513 | 03/12/96 | 03/19/96 | 03/22/96 | |
| 124797-004 | BE-MP08-01 | 26513 | 03/12/96 | 03/19/96 | 03/22/96 | |
| 124797-005 | BE-MP41-01 | 26513 | 03/12/96 | 03/19/96 | 03/22/96 | |

| Analyte<br>Diln Fac: | Units | 124797-001<br>1 | | 124797-002<br>1 | | 124797-004<br>1 | | 124797-005<br>1 | |
|---|---|---|---|---|---|---|---|---|---|
| JP5 | ug/L | 130 | Y | 190 | Y | 710 | YH | 700 | YH |
| Diesel Range | ug/L | <50 | | 94 | YL | 4500 | YH | 4500 | YH |
| Motor Oil Range | ug/L | <300 | | <300 | | 3500 | Y | 3800 | Y |
| **Surrogate** | | | | | | | | | |
| Hexacosane | %REC | 111 | | 106 | | 78 | | 81 | |

Y: Sample exhibits fuel pattern which does not resemble standard
H: Heavier hydrocarbons than indicated standard
L: Lighter hydrocarbons than indicated standard

Curtis & Tompkins, Ltd

Lab #: 124797 BATCH QC REPORT 

| TEH-Tot Ext Hydrocarbons | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | EPA 3520 |
| Location: | Beale AFB | | |

| METHOD BLANK | | | |
|---|---|---|---|
| Matrix: | Water | Prep Date: | 03/19/96 |
| Batch#: | 26513 | Analysis Date: | 03/21/96 |
| Units: | ug/L | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC17466

| Analyte | Result | |
|---|---|---|
| JP5 | <50 | |
| Diesel Range | <50 | |
| Motor Oil Range | <300 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 103 | 60-140 |

Curtis & Tompkins, Ltd

Lab #: 124797

BATCH QC REPORT



TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 3520

BLANK SPIKE/BLANK SPIKE DUPLICATE

Matrix: Water
Batch#: 26513
Units: ug/L
Diln Fac: 1

Prep Date: 03/19/96
Analysis Date: 03/21/96

BS Lab ID: QC17467

| Analyte | Spike Added | BS | %Rec # | Limits |
|---|---|---|---|---|
| Diesel Range | 2475 | 2218 | 90 | 60-140 |
| Surrogate | %Rec | Limits | | |
| Hexacosane | 96 | 60-140 | | |

BSD Lab ID: QC17468

| Analyte | Spike Added | BSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Diesel Range | 2475 | 2330 | 94 | 60-140 | 5 | <35 |
| Surrogate | %Rec | Limits | | | | |
| Hexacosane | 95 | 60-140 | | | | |

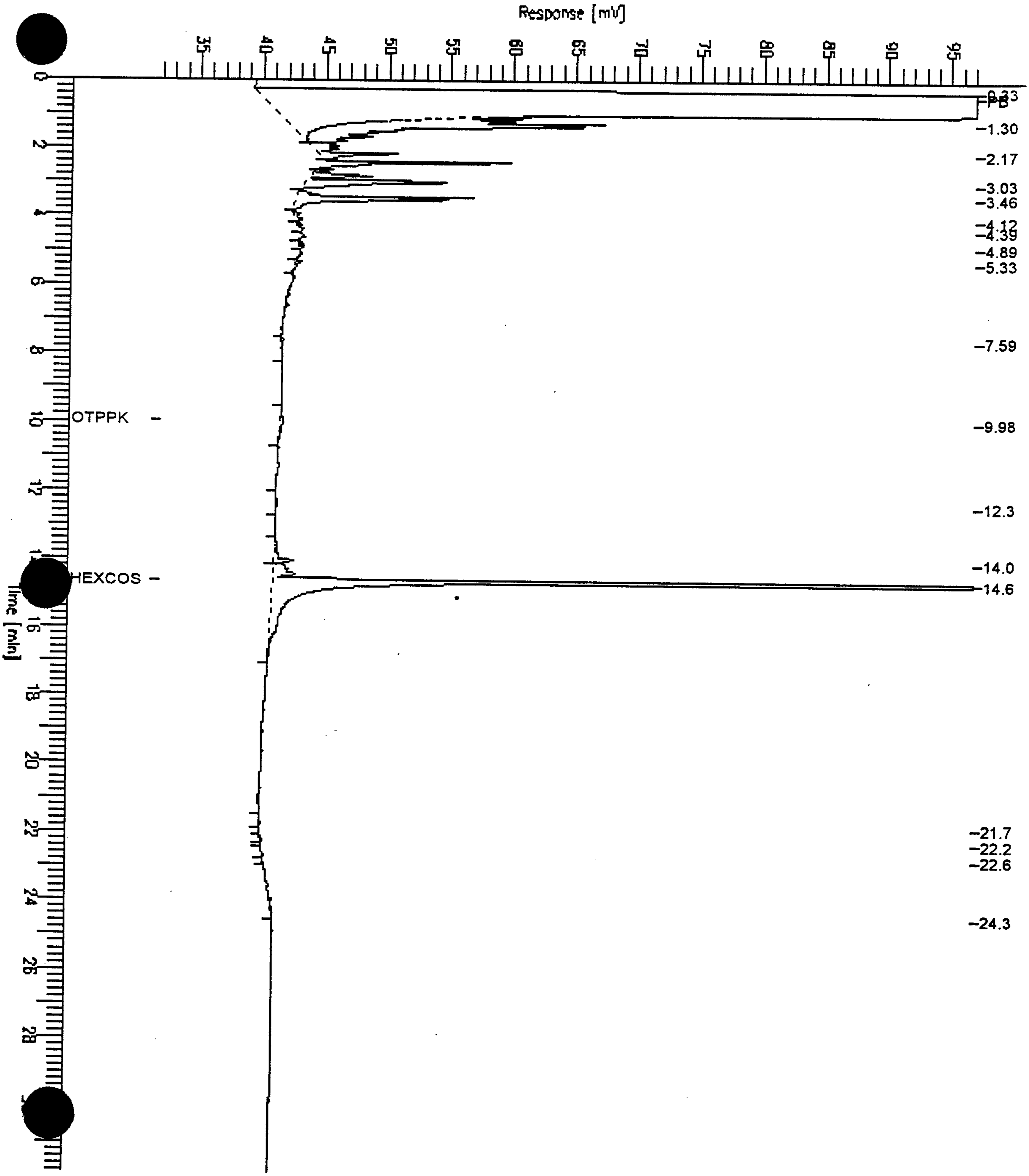
# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

# GC15 Channel A Surrogate

Sample Name : S,124797-001,26513
FileName : C:\GC15\CHB\080B064.raw
Method : DUAL
Start Time : 0.00 min
End Time : 31.90 min
Scale Factor: 0.0
Plot Offset: 32 mV

Sample #: 500:2.5
Date : 3/22/96 02:54 PM
Time of Injection: 3/22/96 02:21 PM
Low Point : 32.00 mV
High Point : 97.00 mV
Plot Scale: 65.0 mV





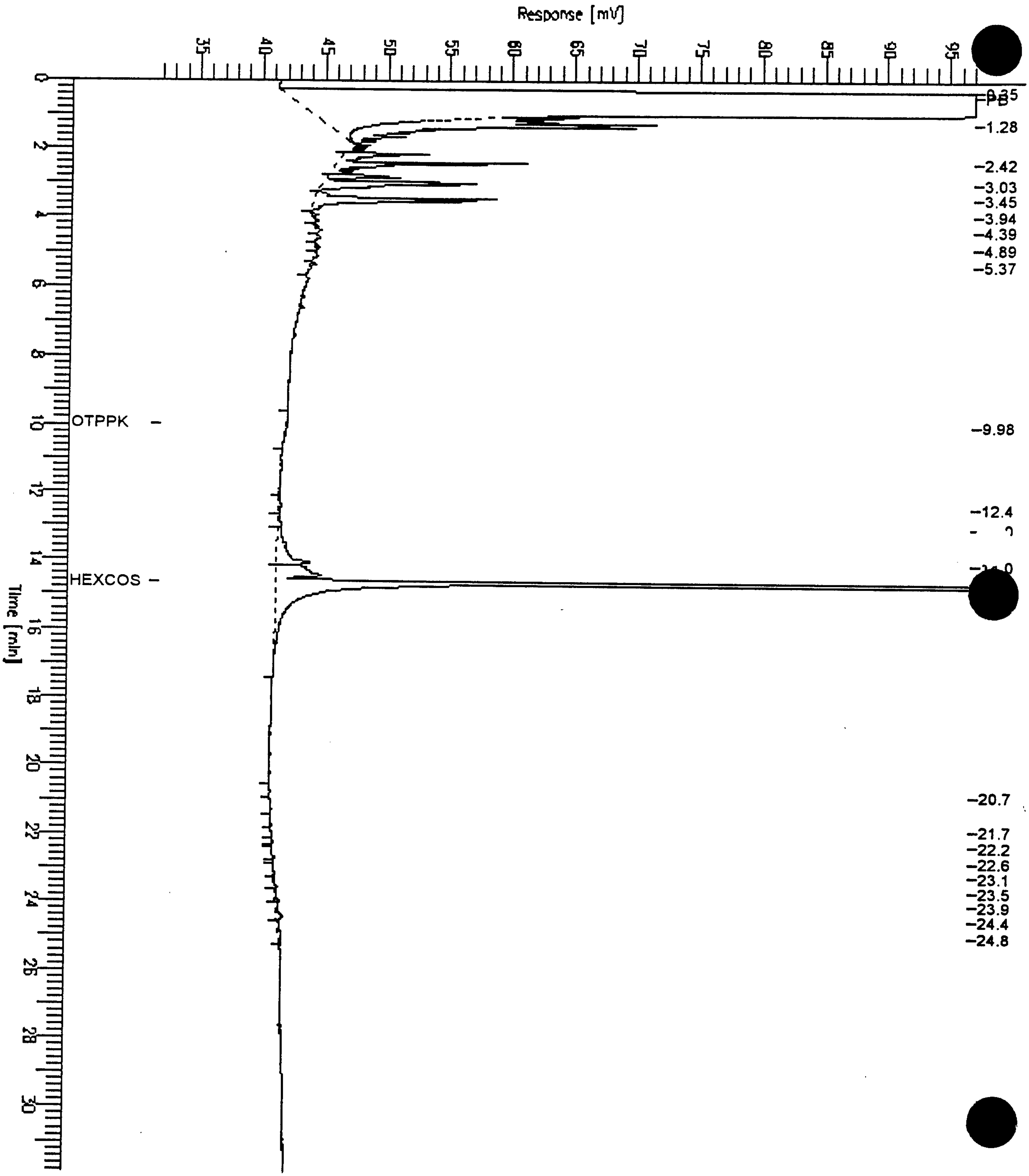
Sample Name : S,124797-002,26513
FileName : C:\GC15\CHB\080B059.raw
Method : DUAL
Start Time : 0.00 min
Scale Factor: 0.0

End Time : 31.90 min
Plot Offset: 32 mV

Sample #: 500:2.5
Date : 3/22/96 11:07 AM
Time of Injection: 3/22/96 10:34 AM
Low Point : 32.00 mV
Plot Scale: 65.0 mV

High Point : 97.00 mV



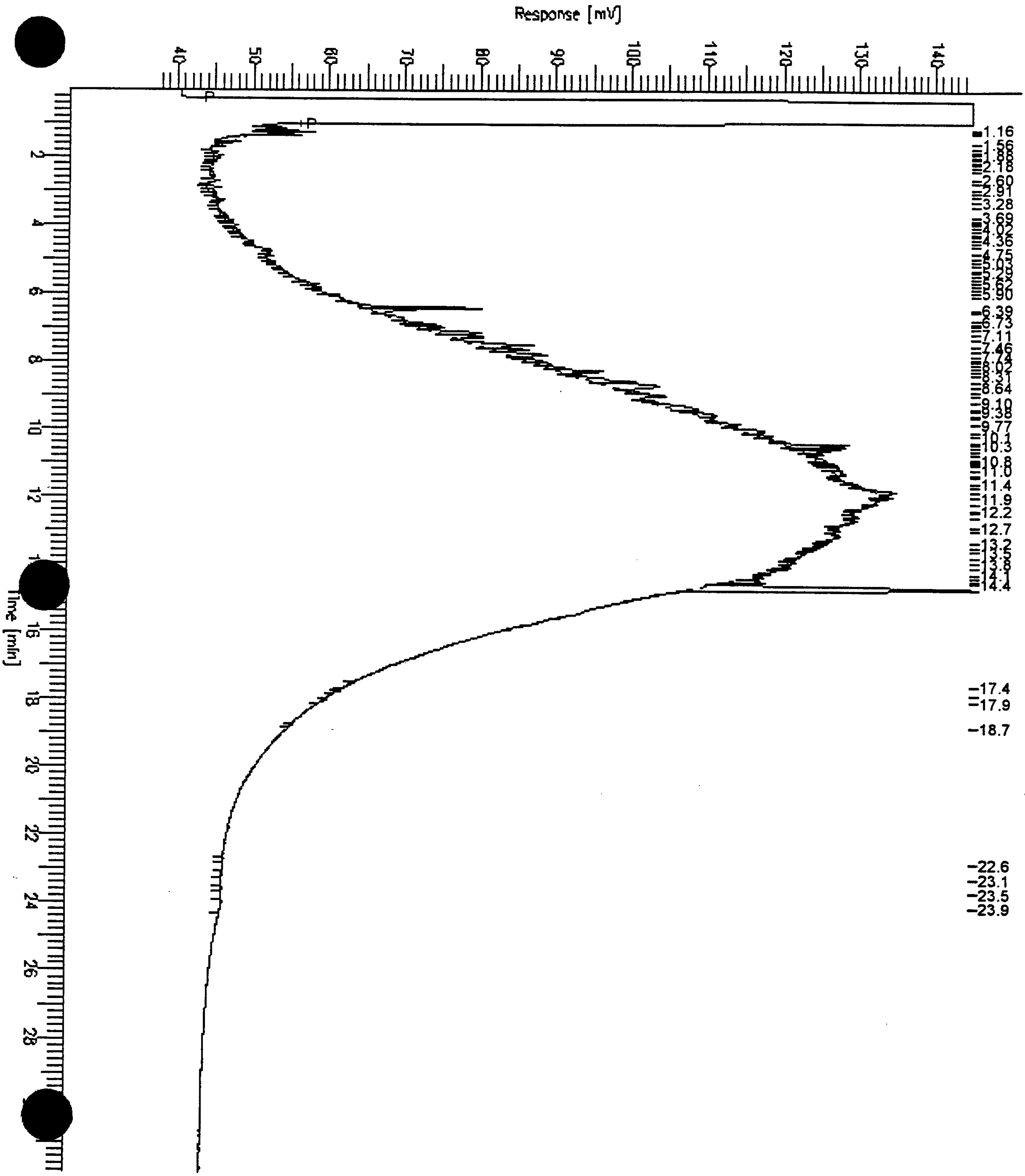


# GC15 Channel A TEH

Sample Name : S,124797-004,26513
FileName : C:\GC15\CHB\080B060.RAW
Method : BTEH.MTH
Start Time : 0.01 min
End Time : 31.91 min
Sc·le Factor: 0.0
Plot Offset: 38 mV

Sample #: 500:2.5
Date : 3/25/96 04:47 PM
Time of Injection: 3/22/96 11:21 AM
Low Point : 37.75 mV
High Point : 144.96 mV
Plot Scale: 107.2 mV

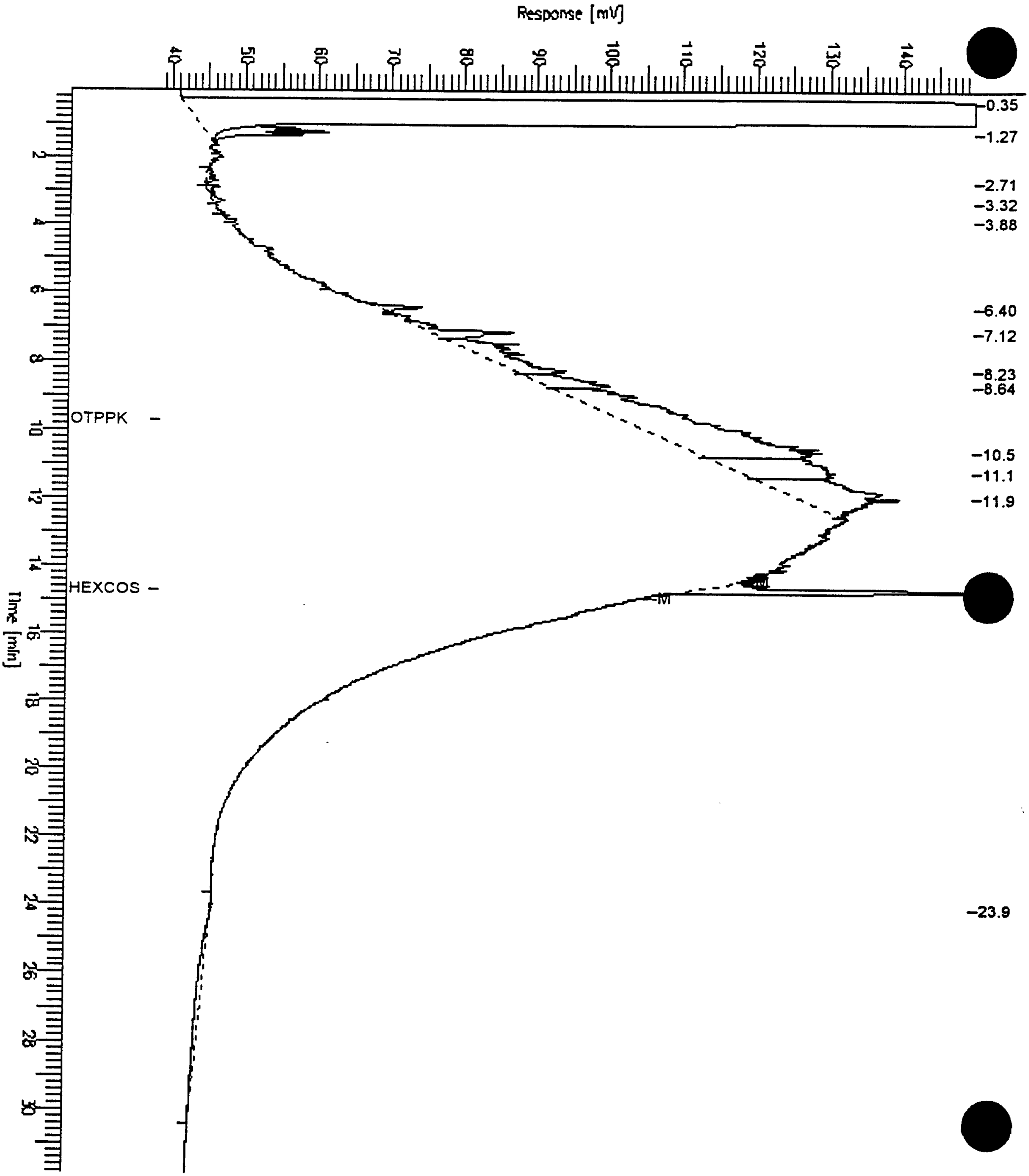




Sample Name : S,124797-005,26513
FileName : C:\GC15\CHB\080B062.RAW
Method : BSURR.MTH
Start Time : 0.01 min
Scale Factor: 0.0
End Time : 31.91 min
Plot Offset: 39 mV

Sample #: 500:2.5
Date : 3/25/96 04:52 PM
Time of Injection: 3/22/96 12:53 PM
Low Point : 38.58 mV
Plot Scale: 111.3 mV
High Point : 149.83 mV





JP-5

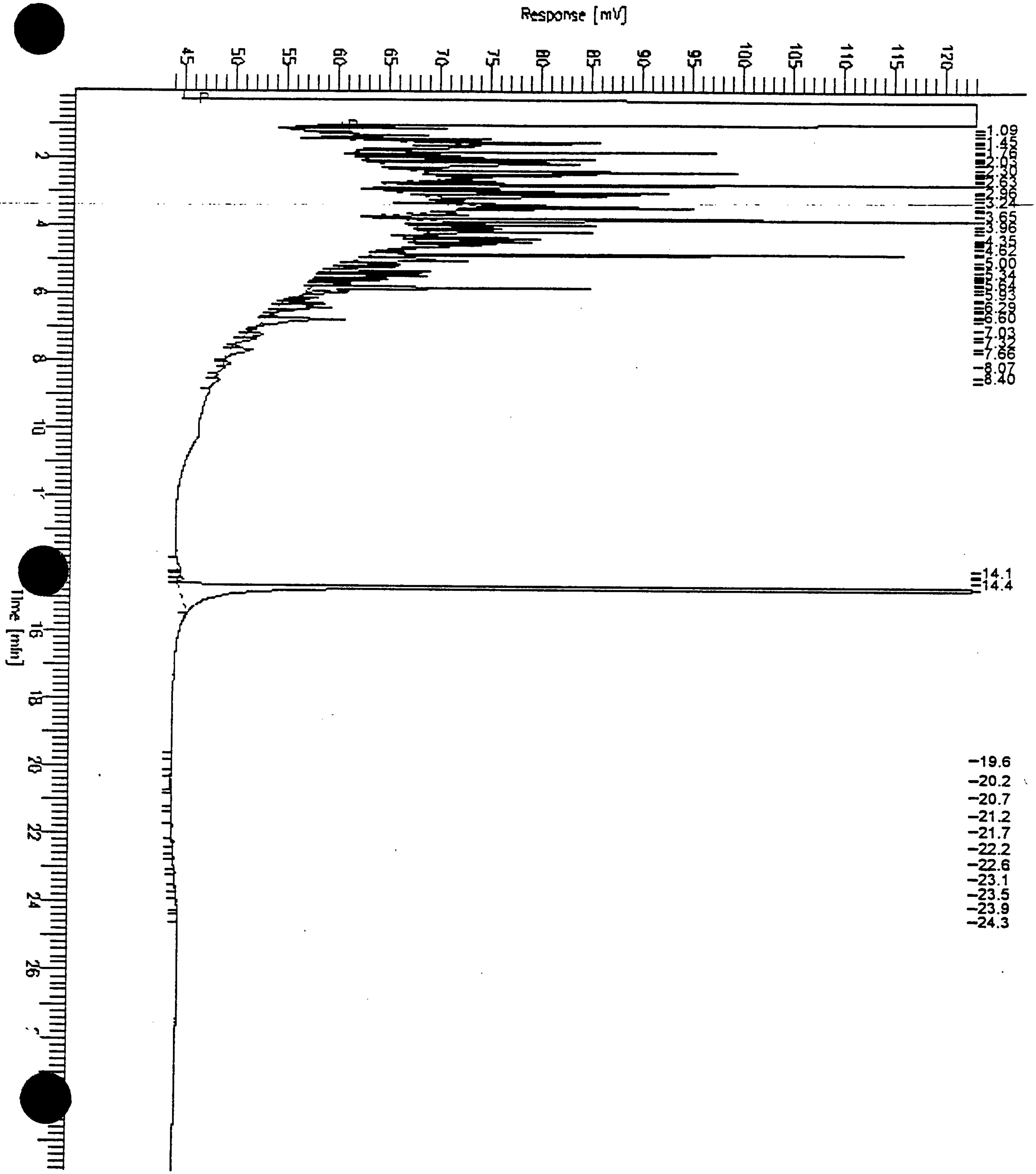
# GC15 Channel A TEH

Sample Name : CCV,96WS2068,JP5
FileName : C:\GC15\CHB\080B050.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Factor: 0.0
End Time : 31.91 min
Plot Offset: 43 mV

Sample #: 250MG/L
Date : 3/25/96 05:13 PM
Time of Injection: 3/22/96 04:00 AM
Low Point : 43.16 mV
Plot Scale: 79.9 mV



High Point : 123.07 mV



Diesel

# GC15 Channel A TEH

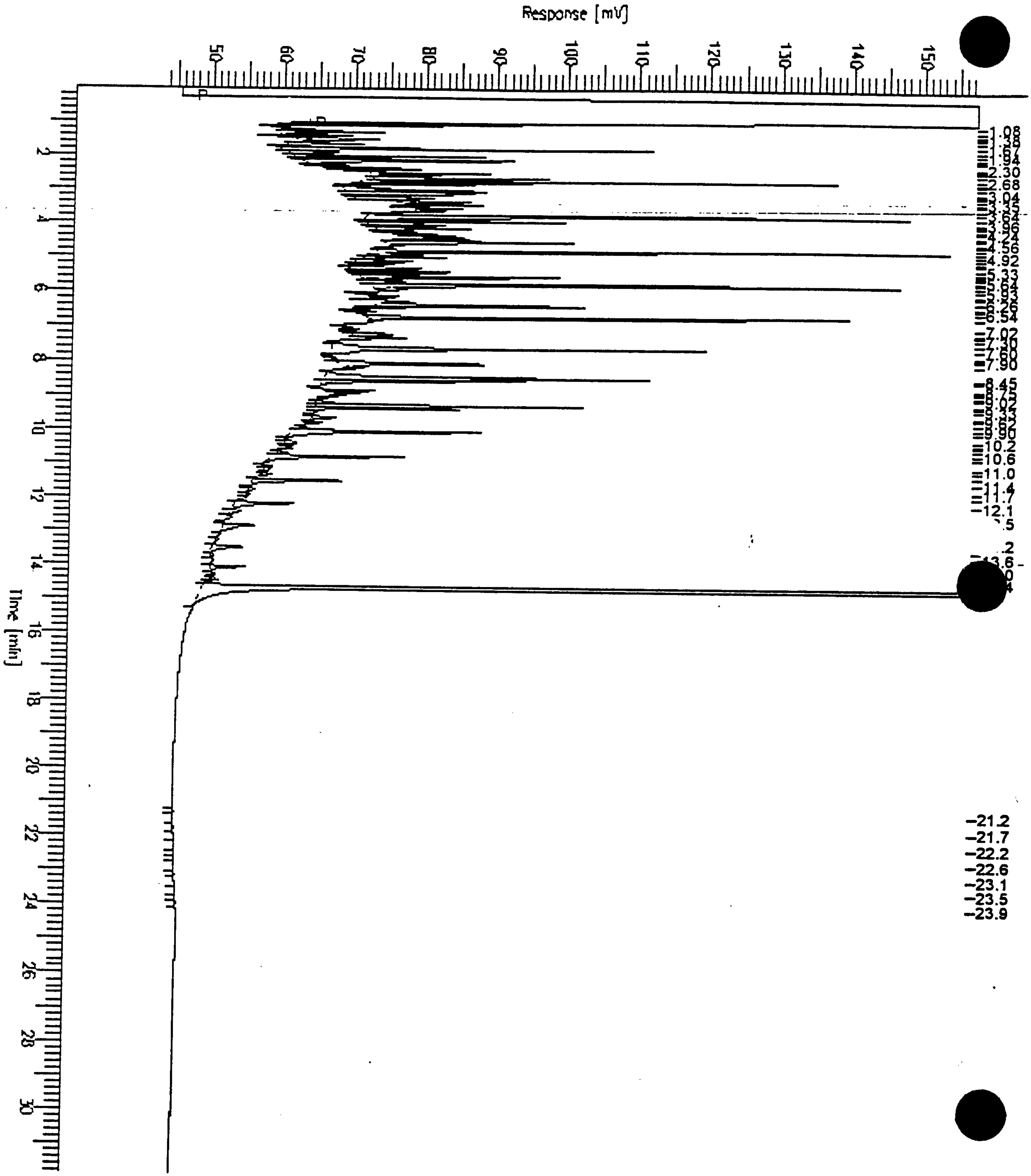
Sample Name : CCV,96WS1948,DSL
FileName : C:\GC15\CHB\080B047.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0

End Time : 31.91 min
Plot Offset: 44 mV

Sample #: 500MG/L
Date : 3/25/96 05:16 PM
Time of Injection: 3/22/96 01:48 AM
Low Point : 43.61 mV
Plot Scale: 113.8 mV



High Point : 157.43 mV

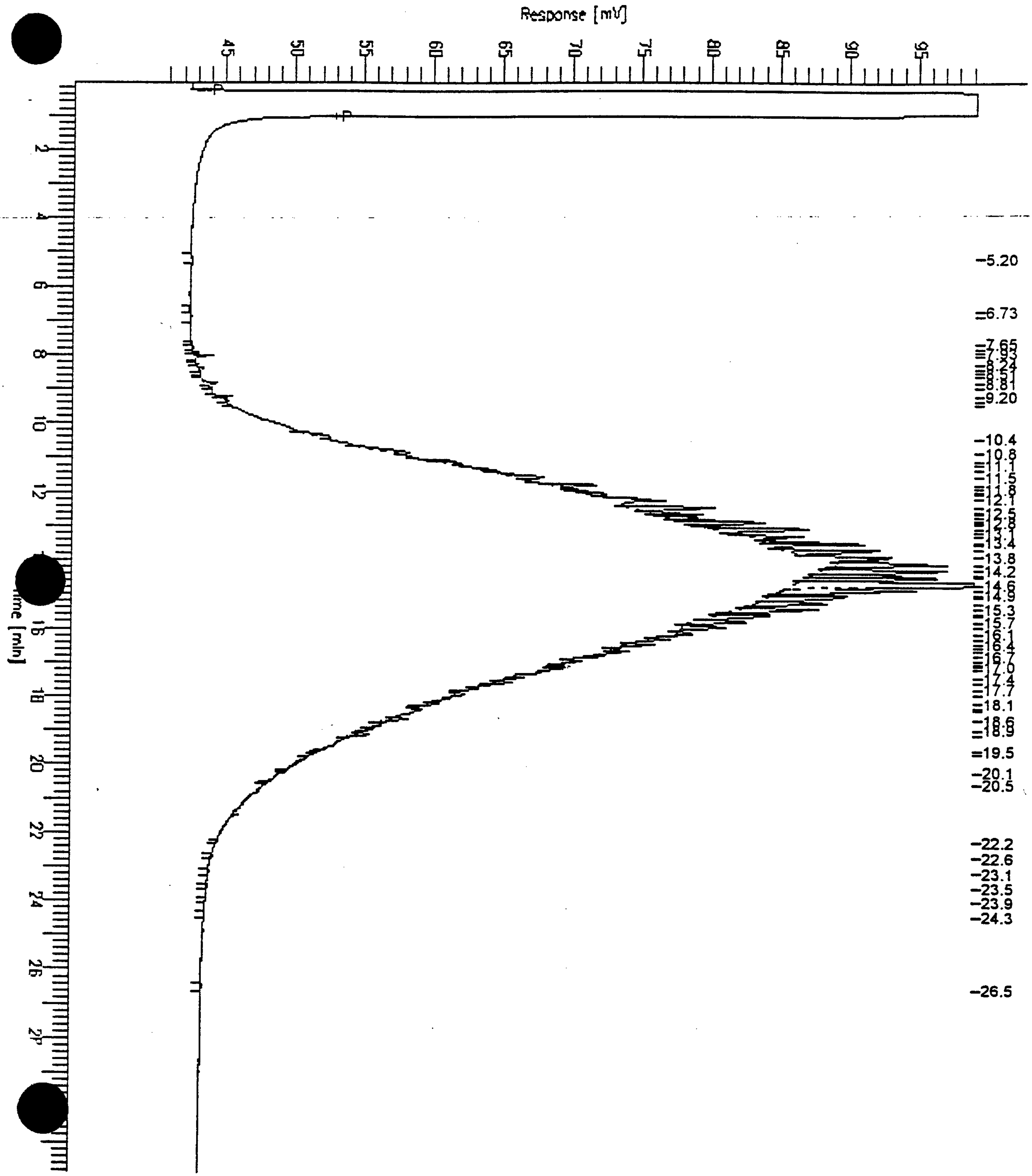


Motor Oil

# GC15 Channel A TEH

Sample Name : CCV,95WS1596,MO
FileName : C:\GC15\CHB\080B051.RAW
Method : BTEH.MTH
Start Time : 0.01 min    End Time : 31.91 min
e Factor: 0.0    Plot Offset: 41 mV

Sample #: 500MG/L    Page 1 of 1
Date : 3/25/96 05:14 PM
Time of Injection: 3/22/96 04:44 AM
Low Point : 40.69 mV    High Point : 99.19 mV
Plot Scale: 58.5 mV



## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124797-001 | BE-MP11-01 | 26573 | 03/12/96 | 03/22/96 | 03/22/96 | |
| 124797-002 | BE-MP44-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |
| 124797-003 | BE-MP45-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |
| 124797-004 | BE-MP08-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |

| Analyte<br>Diln Fac: | Units | 124797-001<br>1 | 124797-002<br>1 | 124797-003<br>1 | 124797-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | ug/L | 380 Y | 410 Y | <50 | <50 |
| Surrogate | | | | | |
| Trifluorotoluene | %REC | 99 | 100 | 99 | 100 |
| Bromobenzene | %REC | 96 | 98 | 95 | 97 |

Y: Sample exhibits fuel pattern which does not resemble standard

Curtis & Tompkins, Ltd



## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124797-005 | BE-MP41-01 | 26573 | 03/12/96 | 03/22/96 | 03/22/96 | |
| 124797-006 | BE-MP46-01 | 26672 | 03/12/96 | 03/27/96 | 03/27/96 | |

| Analyte<br>Diln Fac: | Units | 124797-005<br>1 | 124797-006<br>1 |
|---|---|---|---|
| Gasoline | ug/L | <50 | <50 |
| Surrogate | | | |
| Trifluorotoluene | %REC | 100 | 96 |
| Bromobenzene | %REC | 95 | 94 |

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| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: CA LUFT (EPA 8015M<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Water<br>Batch#: 26573<br>Units: ug/L<br>Diln Fac: 1 | Prep Date: 03/22/96<br>Analysis Date: 03/22/96 |

MB Lab ID: QC17665

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 98 | 69-120 |
| Bromobenzene | 91 | 70-122 |

Curtis & Tompkins, Ltd

Lab #: 124797 BATCH QC REPORT 

TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/27/96 |
| Batch#: 26672 | Analysis Date: 03/27/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC18055

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 95 | 69-120 |
| Bromobenzene | 87 | 70-122 |

Curtis & Tompkins, Ltd

Lab #: 124797 BATCH QC REPORT 

## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

## LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Prep Date: 03/22/96
Analysis Date: 03/22/96

LCS Lab ID: QC17666

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 2008 | 2006 | 100 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 106 | 69-120 |
| Bromobenzene | 112 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd

Lab #: 124797 BATCH QC REPORT 

## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

## LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26672
Units: ug/L
Diln Fac: 1

Prep Date: 03/27/96
Analysis Date: 03/27/96

LCS Lab ID: QC18056

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 1843 | 2006 | 92 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 103 | 69-120 |
| Bromobenzene | 101 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
pike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd.



BATCH QC REPORT



## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: BE-MP46-01
Lab ID: 124797-006
Matrix: Water
Batch#: 26672
Units: ug/L
Diln Fac: 1

Sample Date: 03/12/96
Received Date: 03/13/96
Prep Date: 03/27/96
Analysis Date: 03/27/96

MS Lab ID: QC18058

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 2000 | <50.00 | 2047 | 102 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 104 | 69-120 |
| Bromobenzene | 110 | 70-122 |

MSD Lab ID: QC18059

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 2000 | 2135 | 107 | 75-125 | 4 | <20 |

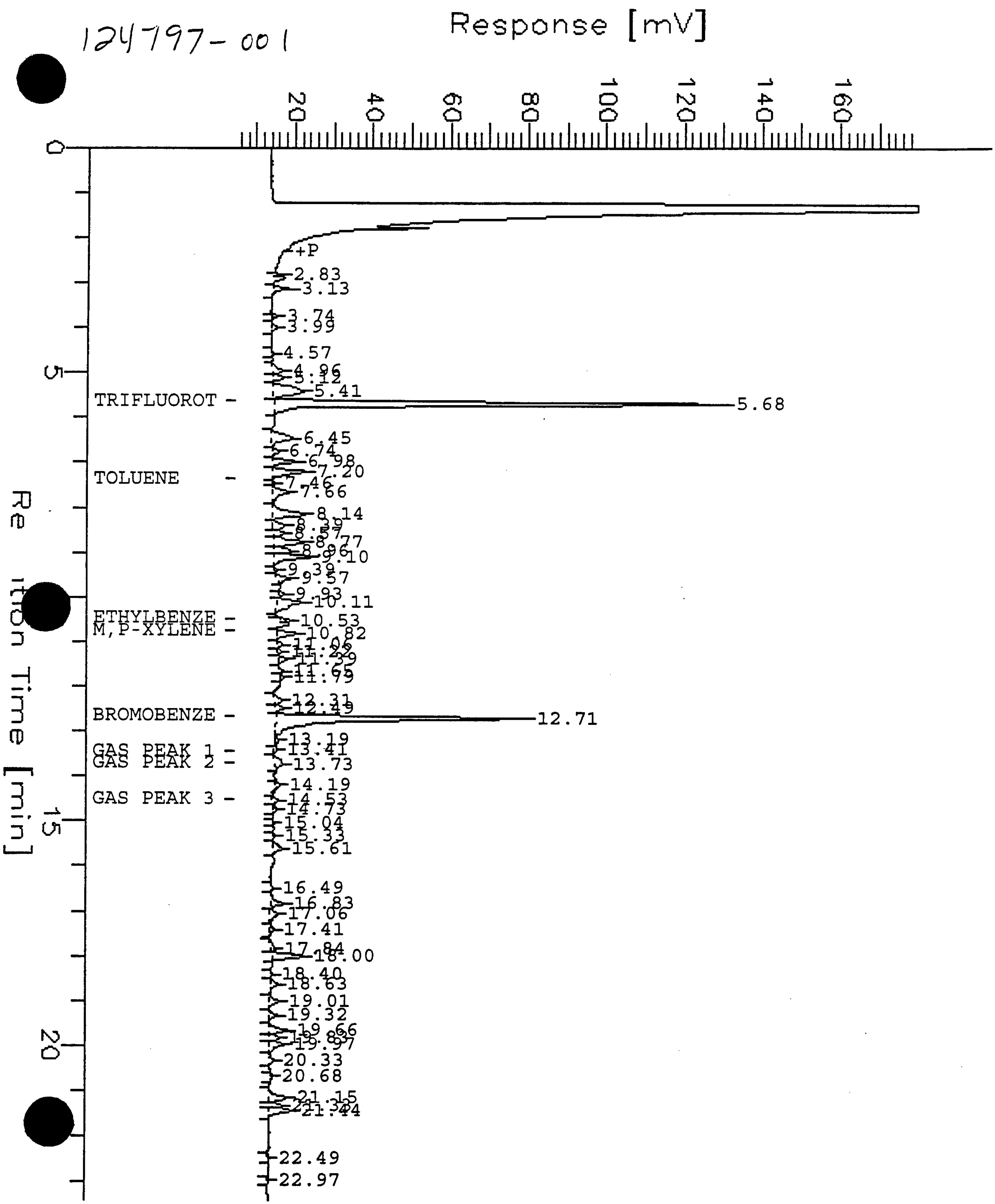
| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 104 | 69-120 |
| Bromobenzene | 114 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

TVH2 - GC-05 RTX-1

FileName : G:\GC05\082H010.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 23.42 min
Plot Offset: 5 mV
Date : 3/22/96 7:13 PM
Low Point : 4.96 mV
Plot Scale: 175 mV
Page 1 of 1
High Point : 179.96 mV

124797-001



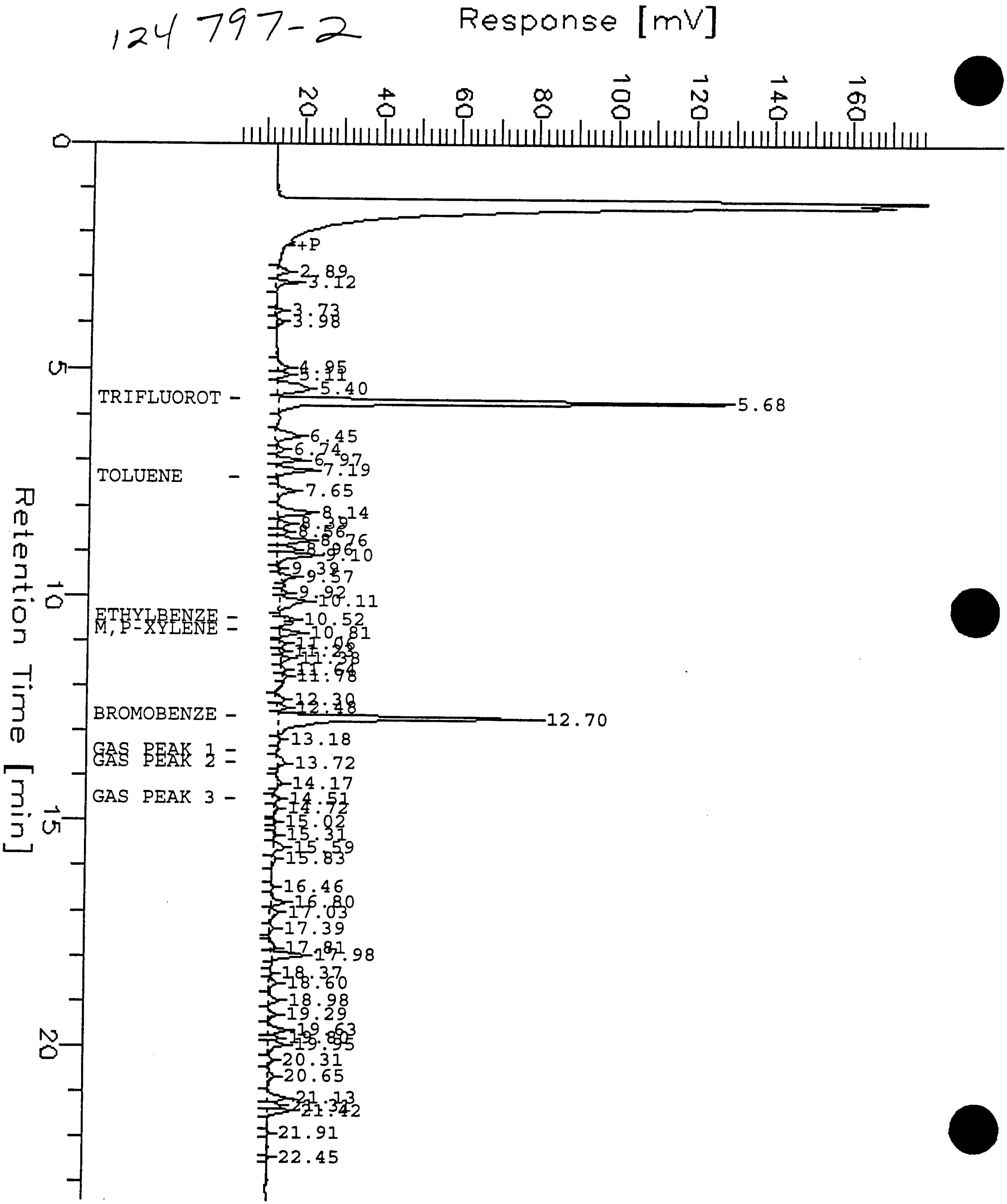
FileName : G:\GC05\082H023.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 23.42 min
Plot Offset: 4 mV

Date : 3/23/96 3:21 AM
Low Point : 3.95 mV
Plot Scale: 175 mV


High Point : 178.95 mV

124797-2



C+T Gasoline Std.

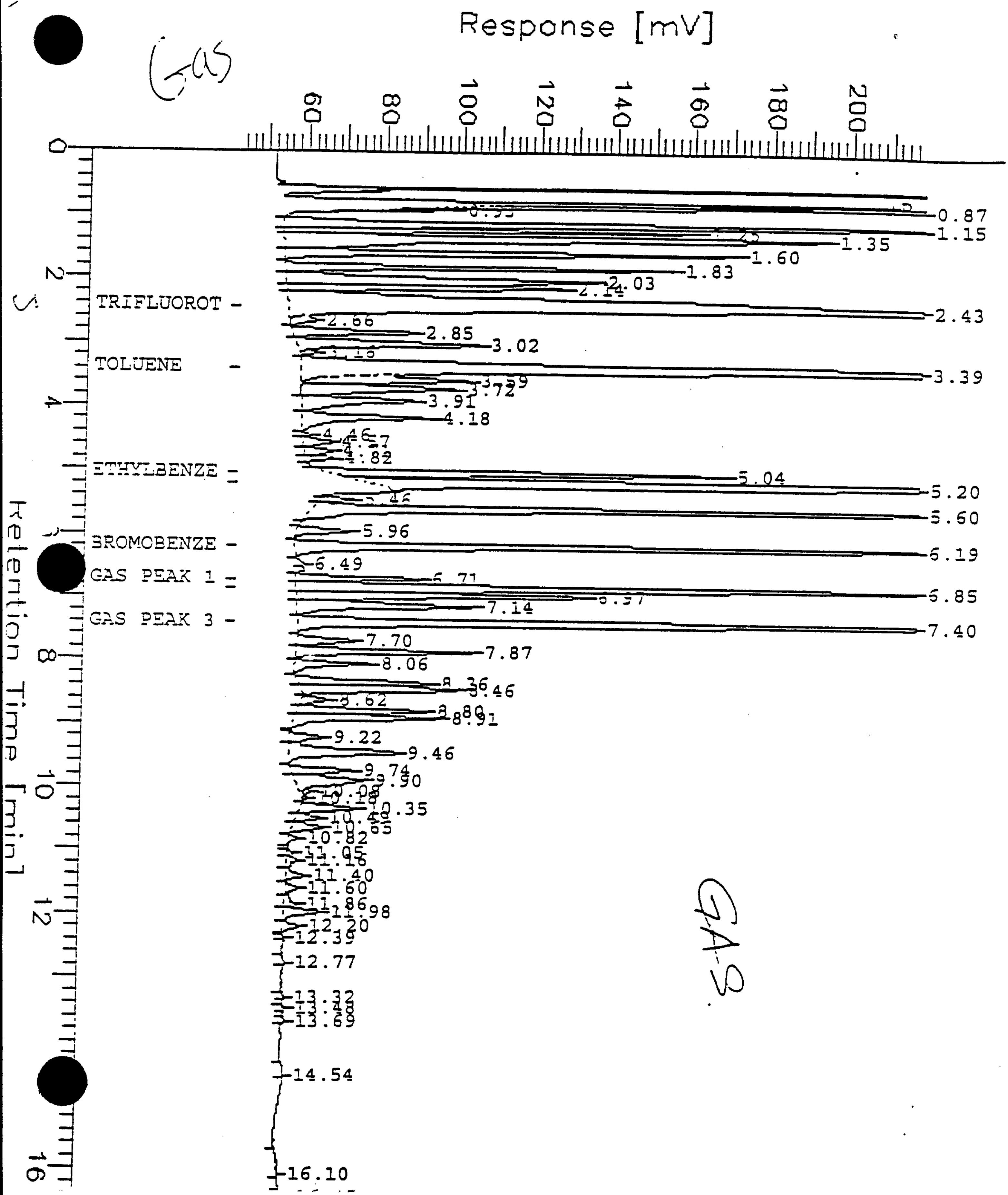
TVH2 - GC-04 RTX-1

FileName : G:\GC04\135J001.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 17.00 min
Plot Offset: 43 mV

Date : 5/15/95 9:53 AM
Low Point : 42.92 mV
Plot Scale: 175 mV

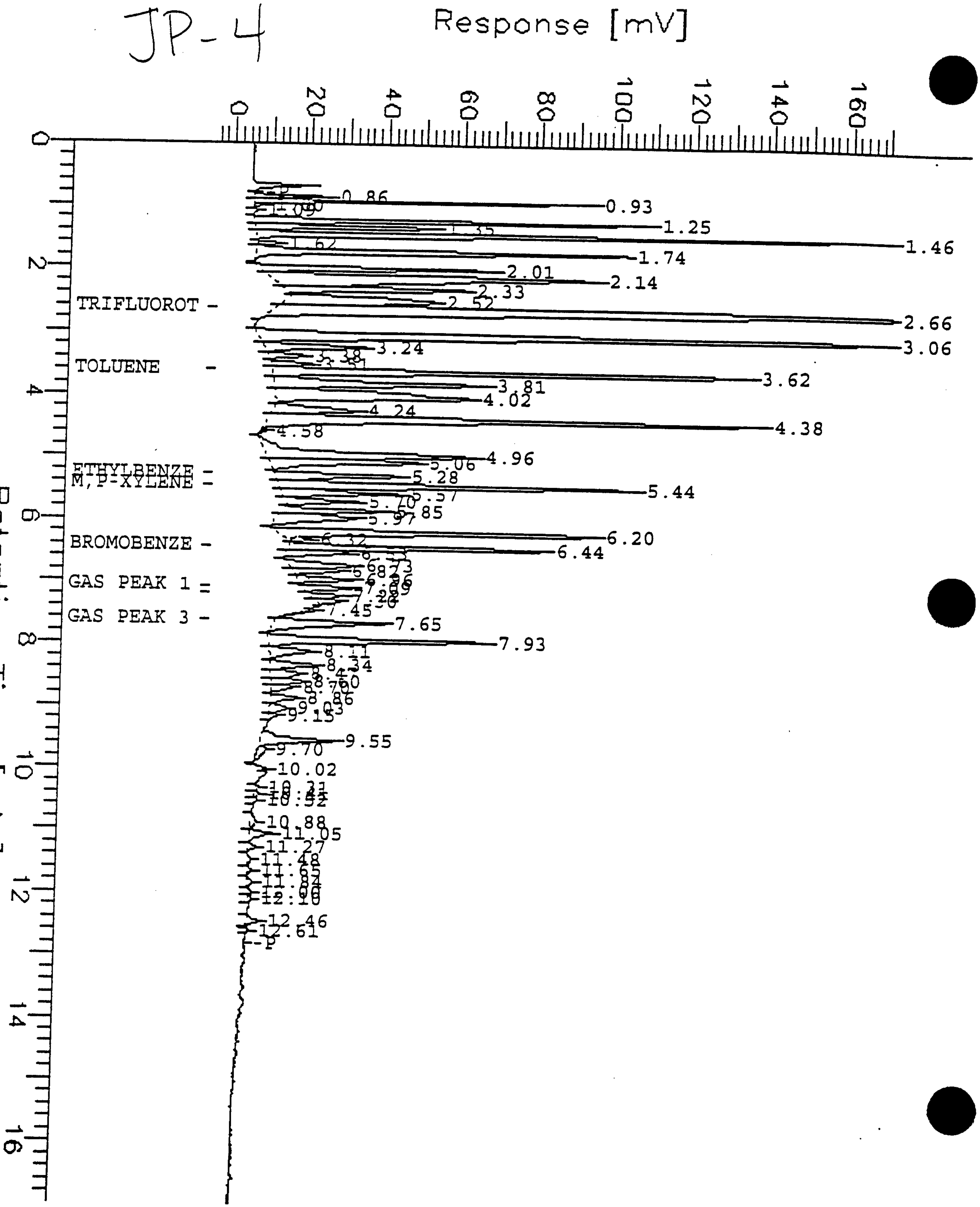
Page 1 of 1
High Point : 217.92 mV



IVH2 - GC-04 RTX-1

FileName : G:\GC04\B\026J011.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 17.00 min
Plot Offset: -4 mV
Date : 2/1/95 3:57 PM
Low Point : -4.15 mV
Plot Scale: 175 mV
Page 1 of 1
High Point : 170.85 mV

JP-4



Curtis & Tompkins, Ltd



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124797-001 | BE-MP11-01 | 26573 | 03/12/96 | 03/22/96 | 03/22/96 | |
| 124797-002 | BE-MP44-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |
| 124797-003 | BE-MP45-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |
| 124797-004 | BE-MP08-01 | 26573 | 03/12/96 | 03/23/96 | 03/23/96 | |

| Analyte<br>Diln Fac: | Units | 124797-001<br>1 | 124797-002<br>1 | 124797-003<br>1 | 124797-004<br>1 |
|---|---|---|---|---|---|
| Benzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| Ethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| ,2,3-Trimethylbenzene | ug/L | <0.5 | 1.4 | <0.5 | <0.5 |
| ,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 98 | 99 | 98 | 80 |
| Bromobenzene | %REC | 91 | 91 | 88 | 84 |

Curtis & Tompkins, Ltd



## BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124797-005 | BE-MP41-01 | 26573 | 03/12/96 | 03/22/96 | 03/22/96 | |
| 124797-006 | BE-MP46-01 | 26672 | 03/12/96 | 03/27/96 | 03/27/96 | |

| Analyte<br>Diln Fac: | Units | 124797-005<br>1 | 124797-006<br>1 |
|---|---|---|---|
| Benzene | ug/L | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 |
| Ethylbenzene | ug/L | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | <0.5 |
| **Surrogate** | | | |
| Trifluorotoluene | %REC | 98 | 97 |
| Bromobenzene | %REC | 89 | 88 |

Curtis & Tompkins, Ltd



**BTXE**

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

**METHOD BLANK**

Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Prep Date: 03/22/96
Analysis Date: 03/22/96

MB Lab ID: QC17665

| Analyte | Result | |
|---|---|---|
| Benzene | <0.5 | |
| Toluene | <0.5 | |
| Ethylbenzene | <0.5 | |
| m,p-Xylenes | <0.5 | |
| o-Xylene | <0.5 | |
| 1,2,3-Trimethylbenzene | <0.5 | |
| 1,2,4-Trimethylbenzene | <0.5 | |
| 1,3,5-Trimethylbenzene | <0.5 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 80 | 58-130 |
| Bromobenzene | 88 | 62-131 |

Curtis & Tompkins, Ltd

Lab #: 124797

BATCH QC REPORT



BTXE

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

METHOD BLANK

| | | | |
|---|---|---|---|
| Matrix: | Water | Prep Date: | 03/27/96 |
| Batch#: | 26672 | Analysis Date: | 03/27/96 |
| Units: | ug/L | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC18055

| Analyte | Result | |
|---|---|---|
| Benzene | <0.5 | |
| Toluene | <0.5 | |
| Ethylbenzene | <0.5 | |
| m,p-Xylenes | <0.5 | |
| o-Xylene | <0.5 | |
| 1,2,3-Trimethylbenzene | <0.5 | |
| 1,2,4-Trimethylbenzene | <0.5 | |
| 1,3,5-Trimethylbenzene | <0.5 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 94 | 58-130 |
| Bromobenzene | 81 | 62-131 |

Curtis & Tompkins, Ltd

Lab #: 124797

# BATCH QC REPORT



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Prep Date: 03/22/96
Analysis Date: 03/22/96

LCS Lab ID: QC17667

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 18.5 | 20 | 93 | 80-120 |
| Toluene | 18.4 | 20 | 92 | 80-120 |
| Ethylbenzene | 18 | 20 | 90 | 80-120 |
| m,p-Xylenes | 36.6 | 40 | 92 | 80-120 |
| o-Xylene | 18.5 | 20 | 93 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 100 | 58-130 |
| Bromobenzene | 90 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
Values outside of QC limits
ke Recovery: 0 out of 5 outside limits

BATCH QC REPORT



BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26672
Units: ug/L
Diln Fac: 1

Prep Date: 03/27/96
Analysis Date: 03/27/96

LCS Lab ID: QC18057

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 16.8 | 20 | 84 | 80-120 |
| Toluene | 17.7 | 20 | 89 | 80-120 |
| Ethylbenzene | 16.2 | 20 | 81 | 80-120 |
| m,p-Xylenes | 36.8 | 40 | 92 | 80-120 |
| o-Xylene | 17.5 | 20 | 88 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 96 | 58-130 |
| Bromobenzene | 81 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd

Lab #: 124797

BATCH QC REPORT



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124900-009
Matrix: Water
Batch#: 26573
Units: ug/L
Diln Fac: 1

Sample Date: 03/19/96
Received Date: 03/20/96
Prep Date: 03/22/96
Analysis Date: 03/22/96

MS Lab ID: QC17668

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Benzene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| Toluene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| Ethylbenzene | 20 | <0.5000 | 19.1 | 96 | 75-125 |
| m,p-Xylenes | 40 | <0.5000 | 38.1 | 95 | 75-125 |
| o-Xylene | 20 | <0.5000 | 19.4 | 97 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 101 | 58-130 |
| Bromobenzene | 91 | 62-131 |

MSD Lab ID: QC17669

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Benzene | 20 | 19.8 | 99 | 75-125 | 4 | <20 |
| Toluene | 20 | 19.7 | 99 | 75-125 | 3 | <20 |
| Ethylbenzene | 20 | 19.5 | 98 | 75-125 | 2 | <20 |
| m,p-Xylenes | 40 | 39 | 98 | 75-125 | 2 | <20 |
| o-Xylene | 20 | 19.8 | 99 | 75-125 | 2 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 101 | 58-130 |
| Bromobenzene | 94 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

**PARSONS ENGINEERING SCIENCE, INC.**
1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

127 717

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020
Project Name/Location: Beale AFB, UST Site
Project Manager: Todd Wiedemeier (Denver, CO)
Site Manager: Michael Phelps (Alameda, CA)
Sampler(s): (Initials and Signature(s))
TXT Tamin Tmper
MHA Michael H Farm

ANALYTES (METHOD) — ORGANICS / INORGANICS / OTHER

| Sample ID | Date | Time | Begin Depth | End Depth | Matrix | NO. OF CONTAINERS | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see note 1 | BTEX and TMBs (5030/8020) see notes 1, 2 | Halogenated VOCs (5030/8010) see notes 1,4 | SVOCs (3550/8270) see note 1 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP11-Ø1 | 3/12/96 | 1330 | — | — | water | 4 | X | X | X | | | |
| BE-MP44-Ø1 | 3/12/96 | 1345 | — | — | water | 4 | X | X | X | | | |
| BE-MP45-Ø1 | 3/12/96 | 1400 | — | — | water | 3 | X | | X | | | |
| BE-MP08-Ø1 | 3/12/96 | 1420 | — | — | water | 4 | X | X | X | | | |
| BE-MP41-Ø1 | 3/12/96 | 1430 | — | — | water | 4 | X | X | X | | | |
| BE-MP46-Ø1 | 3/12/96 | 1445 | — | — | water | 3 | X | | X | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | temperature 4°C |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |

Note: All analyses and holding times according to AFCEE handbook requirements.

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| | | | |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LAB BY: (SIGNATURE) | DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|---|---|---|---|
| Tamin Tmper | 3/12/96 | ~~4:30~~ 1630 | Cynthia E Sellers | 3/1 | | |

NOTES:
1. Secondary column confirmation required.
2. Quantify all carbon ranges: diesel, jet fuel, oil/grease.
3. Deionized water extraction
4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

# COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login#: 124797 Date Received: 3/13/96 Number of Coolers: 1
Client: Parsons Eng. Project: Beale

A. Preliminary Examination Phase
Date Opened: 3/13/96 By (print): Cynthia Schler (sign) Cynthia Schler

1. Did cooler come with a shipping slip (airbill, etc.)? .......... YES NO
   If YES, enter carrier name and airbill number: FEDEX 1154092741
2. Were custody seals on outside of cooler? .......... YES NO
   How many and where? 1 Seal date: ______ Seal name: ______
3. Were custody seals unbroken and intact at the date and time of arrival? .......... YES NO
4. Were custody papers dry and intact when received? .......... YES NO
5. Were custody papers filled out properly (ink, signed, etc.)? .......... YES NO
6. Did you sign the custody papers in the appropriate place? .......... YES NO
7. Was project identifiable from custody papers? .......... YES NO
   If YES, enter project name at the top of this form.
8. If required, was sufficient ice used? .......... YES NO
   Type of ice: real Temperature: 4°C

B. Login Phase
Date Logged In: 3/13/96 By (print): Cynthia Schler (sign) Cynthia Schler

1. Describe type of packing in cooler: paper / bubble wrap
2. Did all bottles arrive unbroken? .......... YES NO
3. Were labels in good condition and complete (ID, date, time, signature, etc.)? .......... YES NO
4. Did bottle labels agree with custody papers? .......... YES NO
5. Were appropriate containers used for the tests indicated? .......... YES NO
6. Were correct preservatives added to samples? .......... YES NO
7. Was sufficient amount of sample sent for tests indicated? .......... YES NO
8. Were bubbles absent in VOA samples? If NO, list sample Ids below .......... YES NO
9. Was the client contacted concerning this sample delivery? .......... YES NO
   If YES, give details below.
   Who was called? ______ By whom? ______ Date: ______

Additional Comments:

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# ANALYTICAL REPORT

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 02-APR-96
Lab Job Number: 124833
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Teresa K Morrison

Reviewed by:

ES ENGINEERING-SCIENCE COMPANIES

MEMORANDUM TO FILE

JOB NO. 722450.14020

FILE DESIGNATION Beale AFB - UST site

DATE 6/14/96 TIME

PHONE CALL FROM Michael Phelps PHONE NO.

PHONE CALL TO PHONE NO.

CONFERENCE WITH

PLACE

SUBJECT Resampled monitoring points MP-10, MP-12, MP-13 and ambient blank (MP-47) due to missed hold times.

Due to missed holding times for samples collected on 3/13/96, the wells were resampled on 5/14/96 and 5/15/96.

SIGNED [signature]

ES SOP 77 (10/91) 211.1000/YO

Curtis & Tompkins, Ltd

**Laboratory Number: 124833**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 03/13/96**
**Receipt Date:03/14/96**

## CASE NARRATIVE

This hardcopy data package contains sample results and batch QC for four water samples and one trip blank received from the above referenced project on March 14, 1996. Two of the VOA vials for sample BE-MP13-01 were broken upon receipt. No TPH/diesel results will be available for sample BE-MP12-01 as no liter amber bottle was submitted. A trip blank was submitted with these samples but was not documented on the chain-of-custody. Per the client request, the trip blank was analyzed for TPH/gasoline and BTXE/TMBs.

**TPH/Extractable:** No analytical problems were encountered.

**TPH/Purgeable:** Due to instrument problems the TPH/gasoline holding times were missed by one day. The samples affected are BE-MP10-01 (C&T# 124833-001), BE-MP12-01 (C&T# 124833-002), BE-MP13-01 (C&T# 124833-003) and BE-MP47-01 (C&T# 124833-004). Bromobenzene failed surrogate recovery limits for sample BE-MP10-01 (C&T# 124833-001), possibly due to coelution of sample hydrocarbons with this surrogate.

**BTXE (EPA 8020):** Due to instrument problems the BTXE/TMB holding times were missed by one day. The samples affected are BE-MP10-01 (C&T# 124833-001), BE-MP12-01 (C&T# 124833-002), BE-MP13-01 (C&T# 124833-003) and BE-MP47-01 (C&T# 124833-004).

Chromatograms are included in this report for any samples containing quantifiable concentrations of extractable or purgeable hydrocarbons, along with example chromatograms for each type of fuel.

**Data Qualifier Flags**

**C:** The "C" qualifier flag indicates that the target compound reported was confirmed by a second analytical column, but that the concentration quantitated on the second column differed from the reported concentration by more than a factor of two. This often happens when the fuel pattern present in the samples does not resemble gasoline.

**DO:** The surrogate recovery could not be calculated due to the dilution required for sample analysis.

**L:** The "L" qualifier flag indicates that the sample chromatogram resembles a fuel pattern, but that the hydrocarbons present are lighter than those seen in a standard of the reported fuel.

**H:** The "H" qualifier flag indicates that the sample chromatogram resembles a fuel pattern, but that the hydrocarbons present are heavier than those seen in a standard of the reported fuel.

**Y:** The "Y" qualifier flag is used to indicate that the sample chromatogram does not resemble the standard for the reported fuel range. This flag is often used in combination with the flags "L" and/or "H".

**Z:** The "Z" qualifier flag indicates that the sample chromatogram does not resemble a fuel pattern, but consists of individual, strongly differentiated peaks.

## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 3520

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124833-001 | BE-MP10-01 | 26564 | 03/13/96 | 03/21/96 | 03/25/96 | |
| 124833-003 | BE-MP13-01 | 26564 | 03/13/96 | 03/21/96 | 03/25/96 | |

| Analyte | Units | 124833-001 | | 124833-003 | |
|---|---|---|---|---|---|
| Diln Fac: | | 1 | | 1 | |
| JP5 | ug/L | 1500 | YH | 2200 | YH |
| Diesel Range | ug/L | 4300 | YLH | 3500 | YHL |
| Motor Oil Range | ug/L | 2200 | YL | 1600 | YL |
| Surrogate | | | | | |
| Hexacosane | %REC | 74 | | 87 | |

Sample exhibits fuel pattern which does not resemble standard
H: Heavier hydrocarbons than indicated standard
L: Lighter hydrocarbons than indicated standard

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| TEH-Tot Ext Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M |
| Project#: 722450.14020 | Prep Method: EPA 3520 |
| Location: Beale AFB | |

| METHOD BLANK | |
|---|---|
| Matrix: Water | Prep Date: 03/21/96 |
| Batch#: 26564 | Analysis Date: 03/25/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC17632

| Analyte | Result | |
|---|---|---|
| JP5 | <50 | |
| Diesel Range | <50 | |
| Motor Oil Range | <300 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 99 | 60-140 |

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Lab #: 124833

# BATCH QC REPORT



## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 3520

## BLANK SPIKE/BLANK SPIKE DUPLICATE

Matrix: Water
Batch#: 26564
Units: ug/L
Diln Fac: 1

Prep Date: 03/21/96
Analysis Date: 03/25/96

BS Lab ID: QC17633

| Analyte | Spike Added | BS | %Rec # | Limits |
|---|---|---|---|---|
| Diesel Range | 2475 | 2265 | 92 | 60-140 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 90 | 60-140 |

BSD Lab ID: QC17634

| Analyte | Spike Added | BSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Diesel Range | 2475 | 2355 | 95 | 60-140 | 4 | <35 |

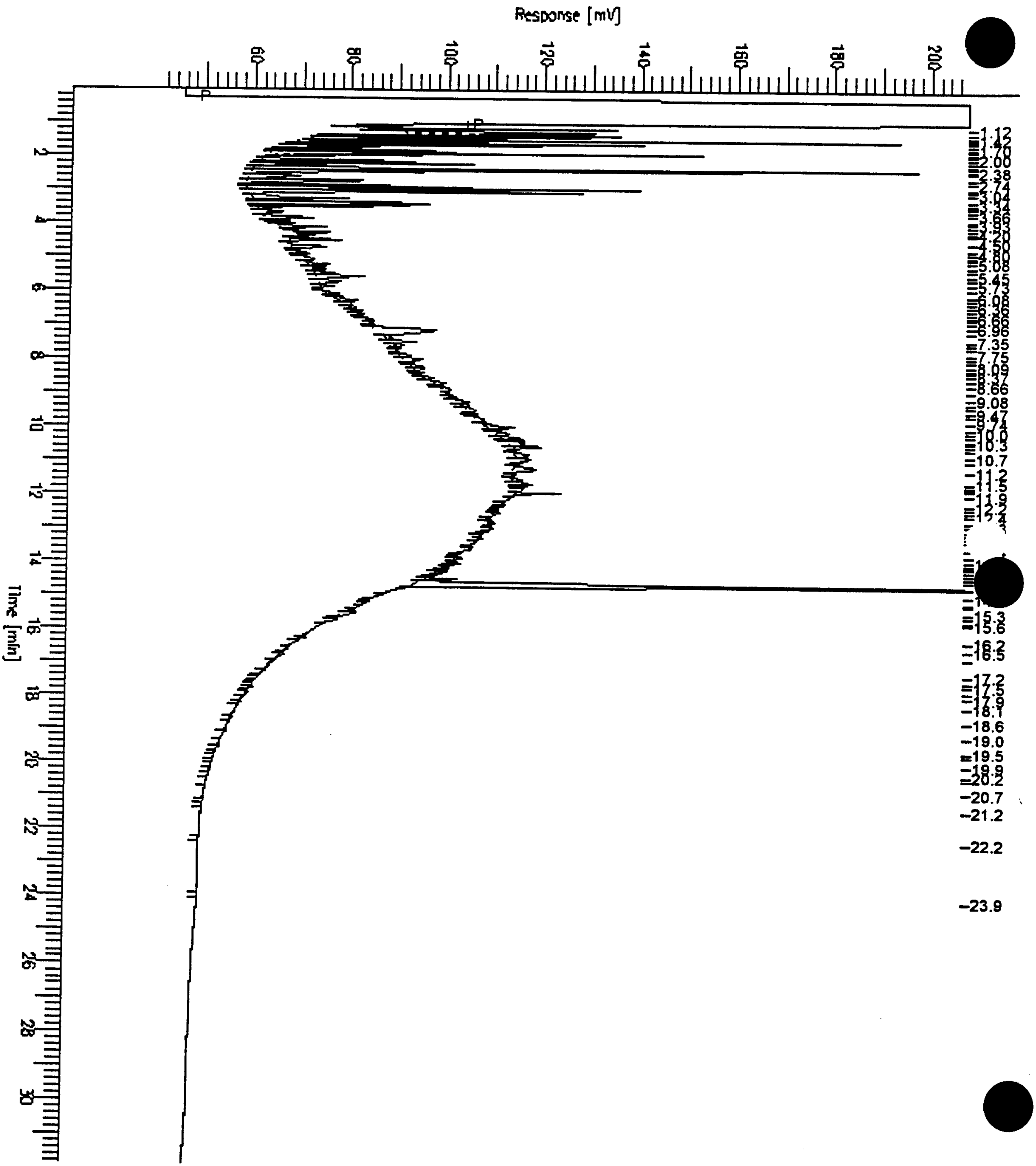
| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 88 | 60-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

Sample Name : S,124833-001,26564
FileName : C:\GC15\CHB\084B016.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0
End Time : 31.91 min
Plot Offset: 41 mV

Sample #: 500:2.5
Date : 3/27/96 10:51 AM
Time of Injection: 3/25/96 09:09 AM
Low Point : 40.83 mV
Plot Scale: 166.9 mV
High Point : 207.76 mV



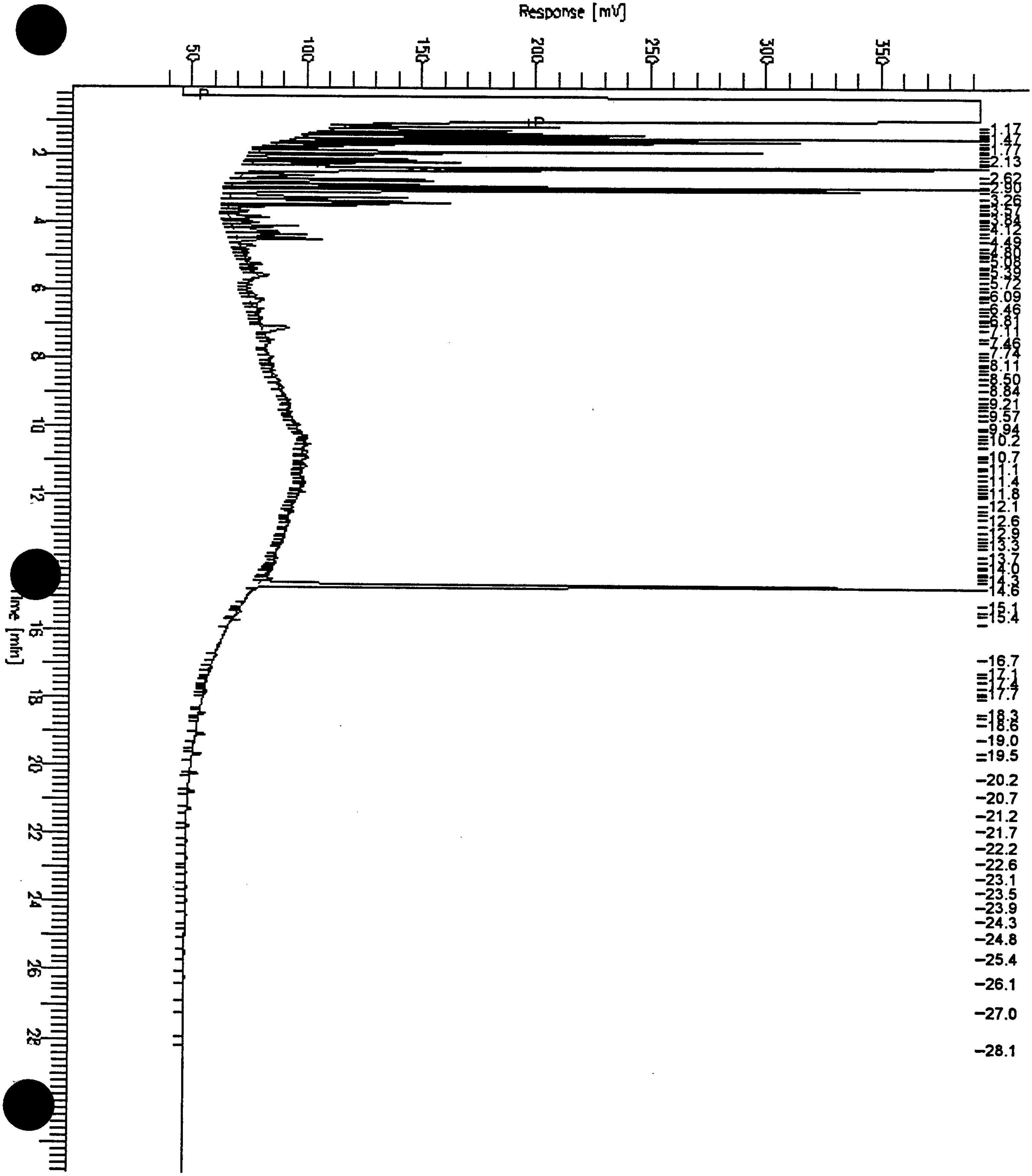


# GC15 Channel A TEH

Sample Name : S,124833-003,26564
FileName : C:\GC15\CHB\084B017.RAW
Method : BTEH.MTH
Start Time : 0.01 min End Time : 31.91 min
S · Factor: 0.0 Plot Offset: 38 mV

Sample #: 500:2.5
Date : 3/27/96 10:53 AM
Time of Injection: 3/25/96 09:53 AM
Low Point : 37.93 mV High Point : 393.26 mV
Plot Scale: 355.3 mV





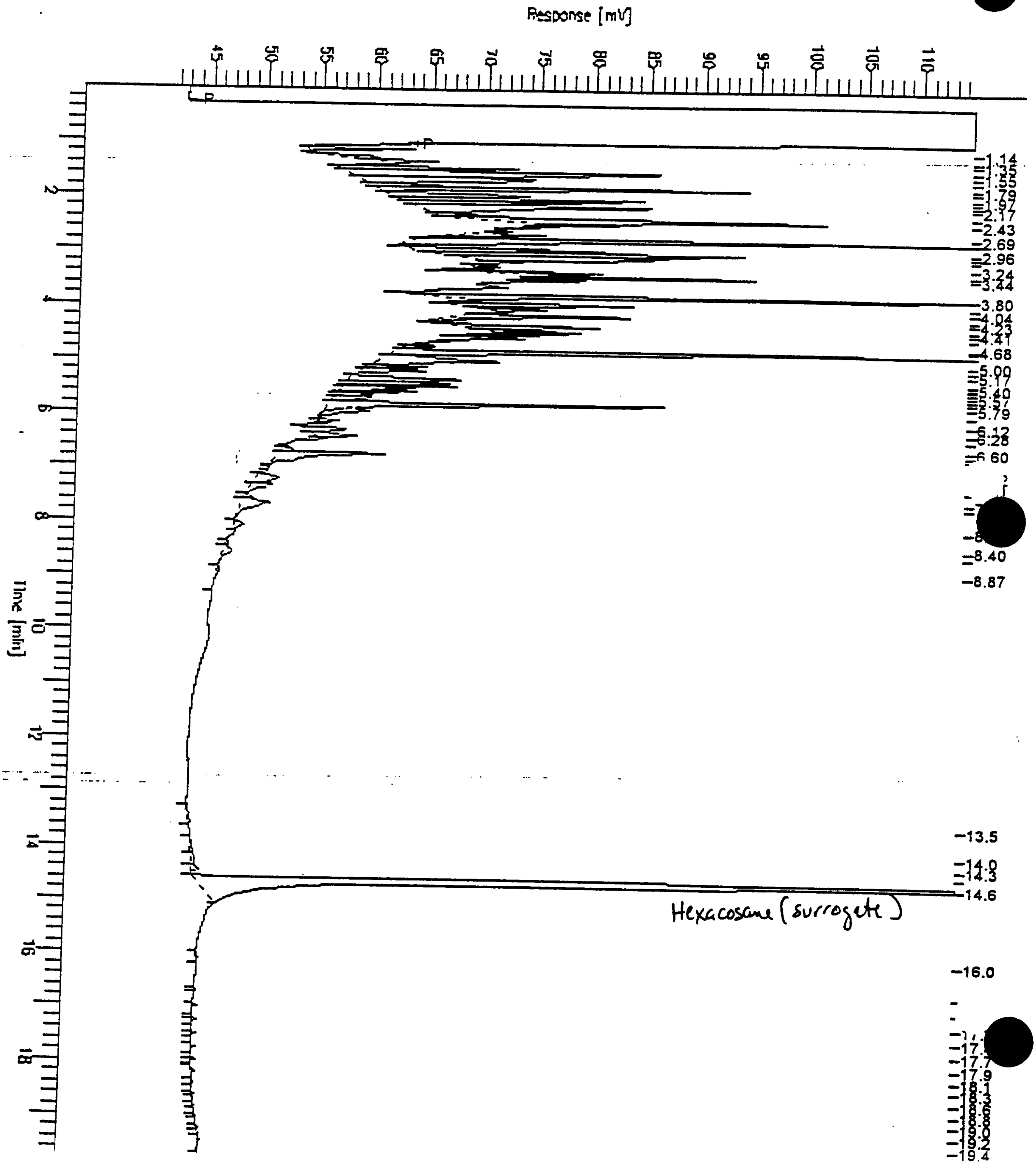
JP-5

# GC15 Channel A TEH

Sample Name : CCV,96WS2069,JP5
FileName : C:\GC15\CHB\084B023.RAW
Method : BTEH.MTH
Start Time : 0.01 min
End Time : 19.80 min
Scale Factor: 0.0
Plot Offset: 42 mV

Sample #: 250MG/L
Date : 3/26/96 12:54 PM
Time of Injection: 3/25/96 01:29 PM
Low Point : 41.54 mV
High Point : 114.59 mV
Plot Scale: 73.1 mV





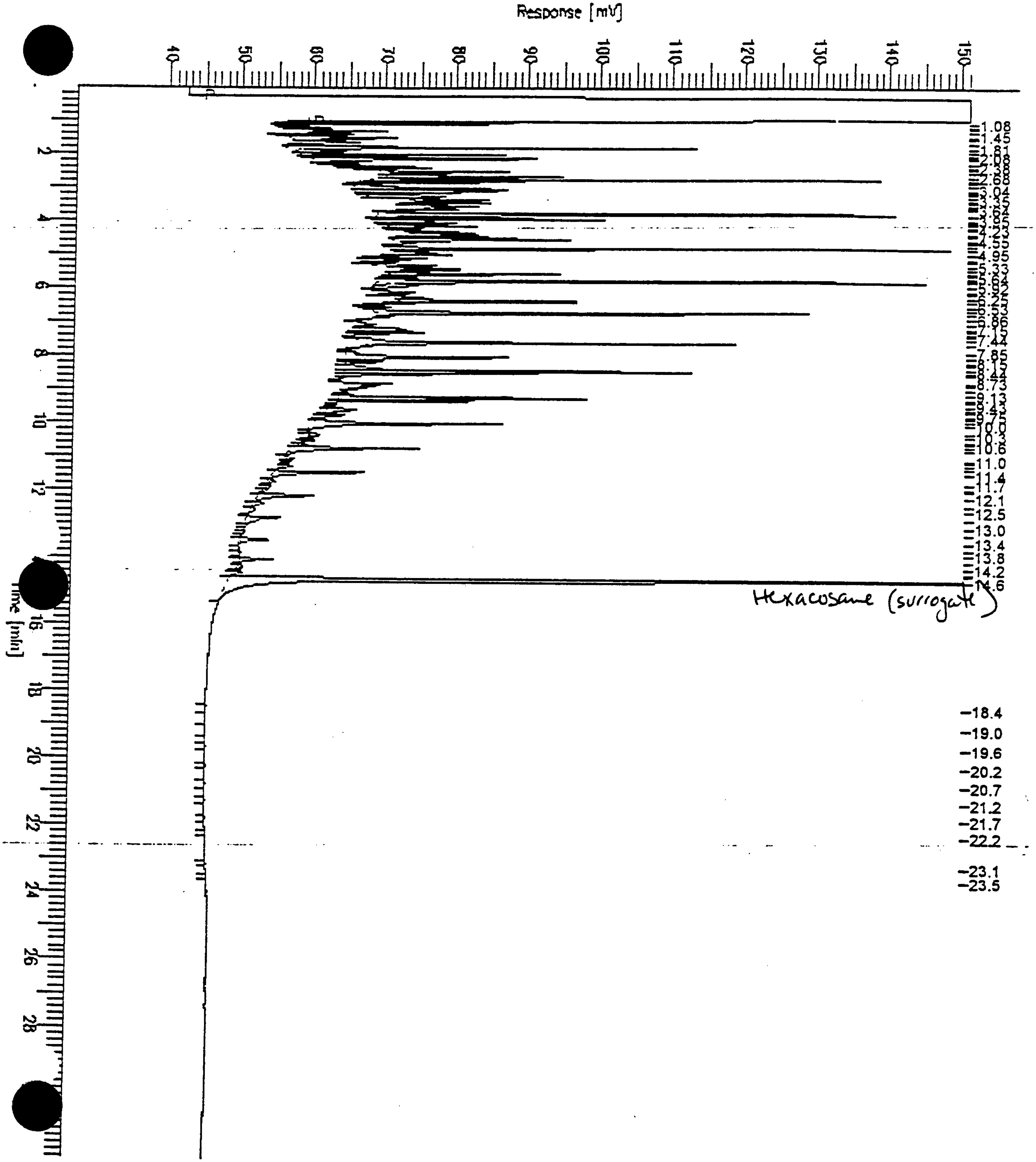
Diesel

Sample Name : CCV,96WS1948,DSL
FileName : C:\GC15\CHB\084B039.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0
End Time : 31.91 min
Plot Offset: 40 mV

Sample #: 500MG/L
Date : 3/26/96 12:58 PM
Time of Injection: 3/26/96 12:04 AM
Low Point : 39.68 mV
Plot Scale: 111.4 mV



High Point : 151.11 mV



motor oil

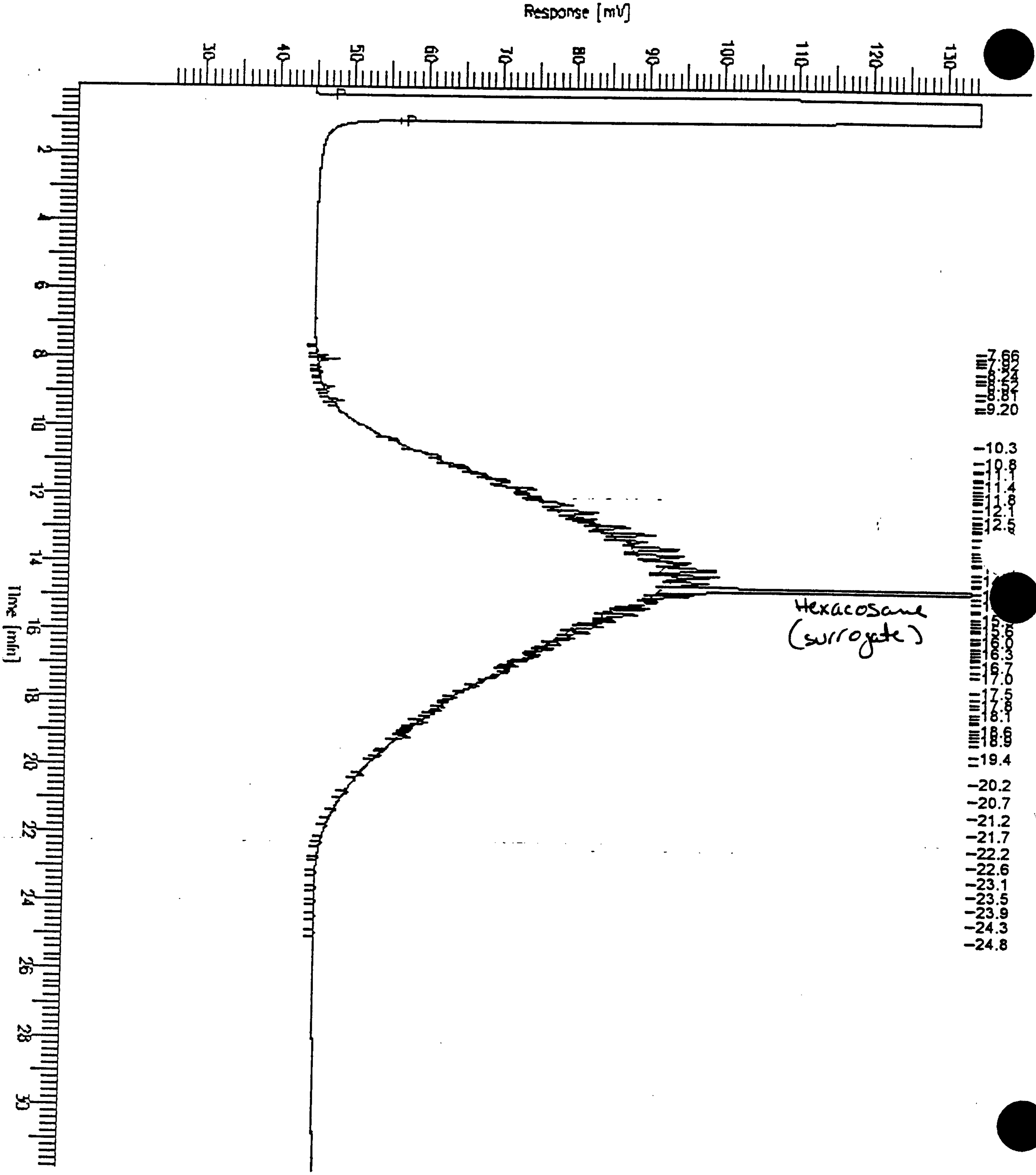
Sample Name : CCV,96WS2112,MO
FileName : C:\GC15\CHB\084B042.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0

End Time : 31.91 min
Plot Offset: 25 mV

Sample #: 500MG/L
Date : 3/26/96 12:55 PM
Time of Injection: 3/26/96 02:17 AM
Low Point : 25.07 mV
Plot Scale: 109.4 mV

High Point : 134.45 mV





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## TVH-Total Volatile Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124833-001 | BE-MP10-01 | 26672 | 03/13/96 | 03/28/96 | 03/28/96 | |
| 124833-002 | BE-MP12-01 | 26672 | 03/13/96 | 03/28/96 | 03/28/96 | |
| 124833-003 | BE-MP13-01 | 26672 | 03/13/96 | 03/28/96 | 03/28/96 | |
| 124833-004 | BE-MP47-01 | 26672 | 03/13/96 | 03/28/96 | 03/28/96 | |

| Analyte<br>Diln Fac: | Units | 124833-001<br>1 | 124833-002<br>1 | 124833-003<br>10 | 124833-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | ug/L | 1600 | <50 | 5200 | <50 |
| Surrogate | | | | | |
| Trifluorotoluene | %REC | 104 | 99 | 99 | 100 |
| Bromobenzene | %REC | 125 * | 105 | 105 | 98 |

* Values outside of QC limits

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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124833-005 | TRIP BLANK | 26672 | 03/13/96 | 03/27/96 | 03/27/96 | |

| Analyte<br>Diln Fac: | Units | 124833-005<br>1 |
|---|---|---|
| Gasoline | ug/L | <50 |
| Surrogate | | |
| Trifluorotoluene | %REC | 99 |
| Bromobenzene | %REC | 95 |

Curtis & Tompkins, Ltd

Lab #: 124833

# BATCH QC REPORT



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/27/96 |
| Batch#: 26672 | Analysis Date: 03/27/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC18055

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 95 | 69-120 |
| Bromobenzene | 87 | 70-122 |

## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

## LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26672
Units: ug/L
Diln Fac: 1

Prep Date: 03/27/96
Analysis Date: 03/27/96

LCS Lab ID: QC18056

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 1843 | 2006 | 92 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 103 | 69-120 |
| Bromobenzene | 101 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Lab #: 124833 BATCH QC REPORT 

## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

| | |
|---|---|
| Field ID: ZZZZZZ | Sample Date: 03/12/96 |
| Lab ID: 124797-006 | Received Date: 03/13/96 |
| Matrix: Water | Prep Date: 03/27/96 |
| Batch#: 26672 | Analysis Date: 03/27/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MS Lab ID: QC18058

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 2000 | <50.00 | 2047 | 102 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 104 | 69-120 |
| Bromobenzene | 110 | 70-122 |

MSD Lab ID: QC18059

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 2000 | 2135 | 107 | 75-125 | 4 | <20 |

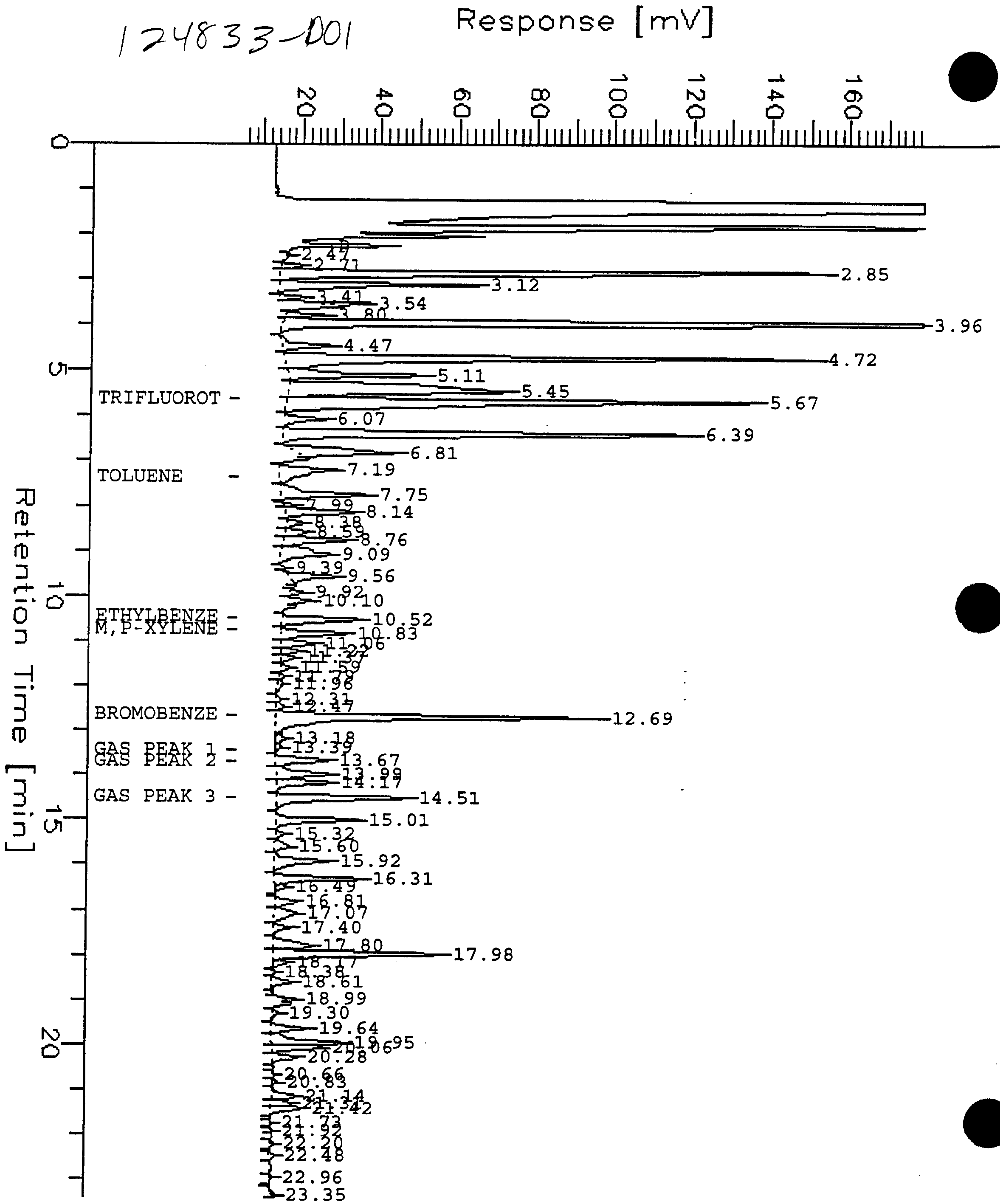
| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 104 | 69-120 |
| Bromobenzene | 114 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

TVH2 - GC-05 RTX-1

FileName : G:\GC05\087H026.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 23.42 min
Plot Offset: 4 mV
Date : 3/28/96 5:51 AM
Low Point : 4.03 mV
Plot Scale: 175 mV
Page 1 of 1
High Point : 179.03 mV

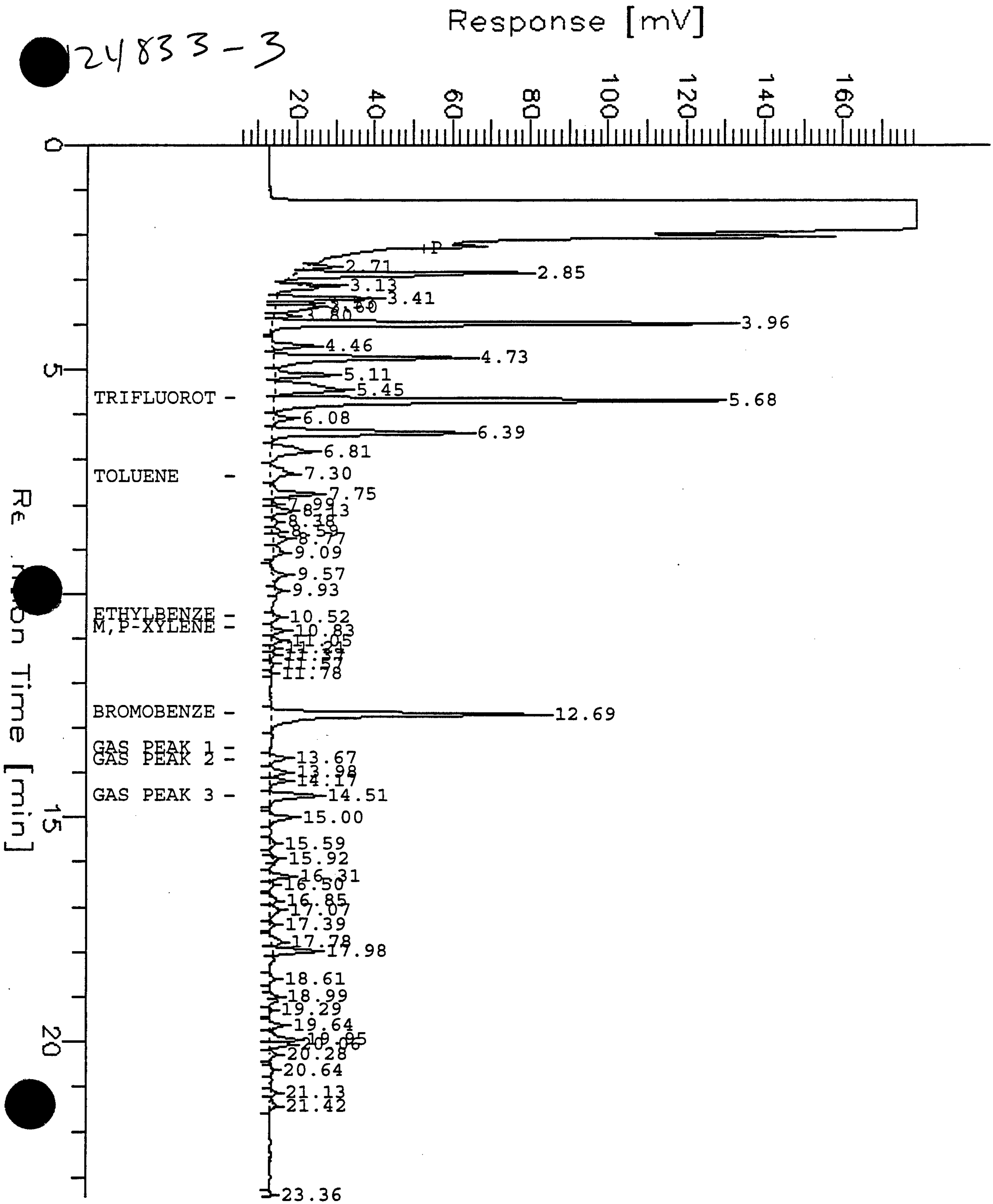
124833-D01



TVH2 - GC-05 RTX-1

FileName : G:\GC05\087H025.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 23.42 min
Plot Offset: 4 mV
Date : 3/28/96 5:13 AM
Low Point : 4.07 mV
Plot Scale: 175 mV
Page 1 of 1
High Point : 179.07 mV

24833-3



C+T Gasoline Std.

TVH2 - GC-04 RTX-1

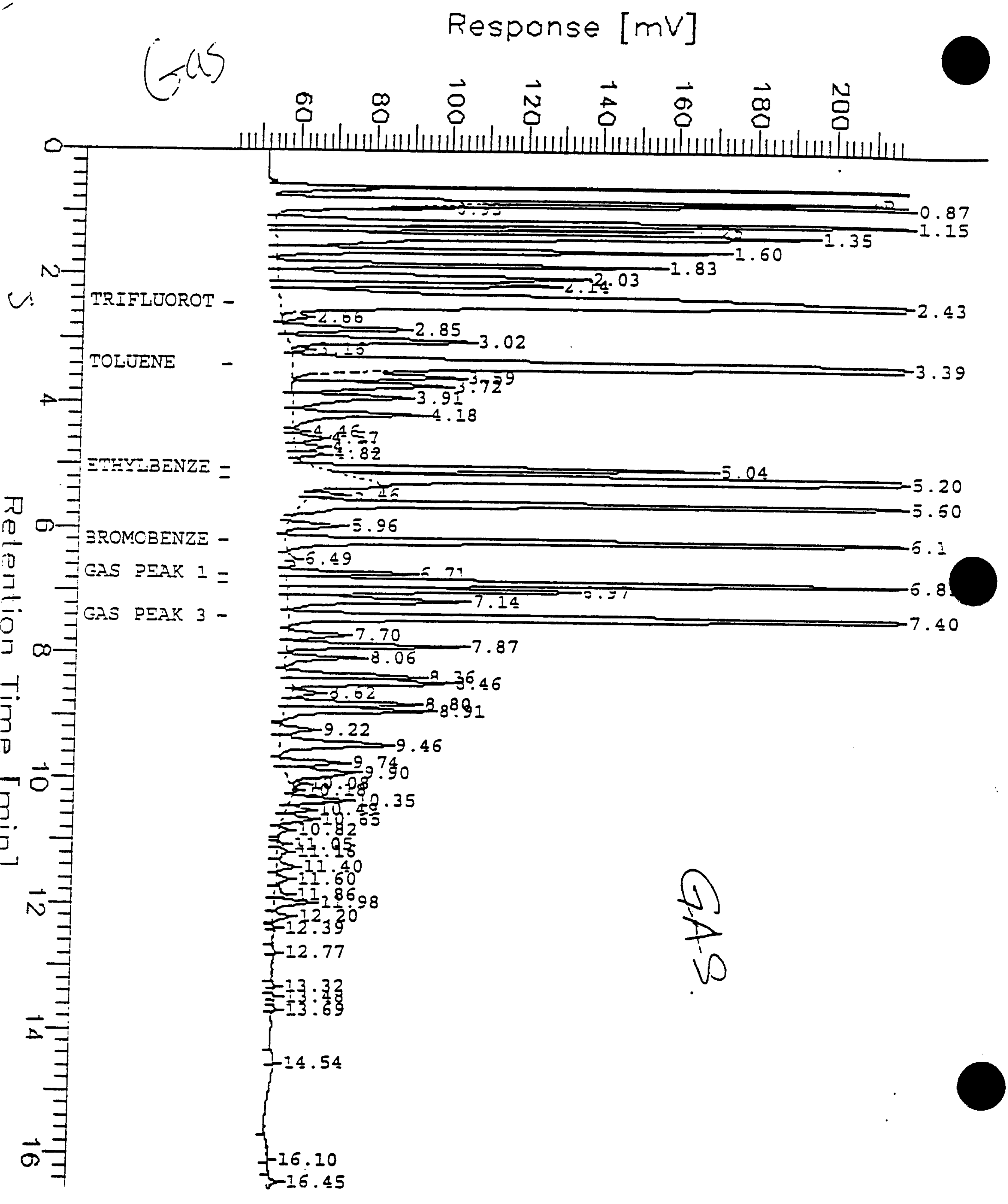
FileName : G:\GC04\135J001.raw
Start Time : 0.00 min
Scale Factor: -1

End Time : 17.00 min
Plot Offset: 43 mV

Date : 5/15/95 9:53 AM
Low Point : 42.92 mV
Plot Scale: 175 mV



High Point : 217.92 mV



TVH2 - GC-04 RTX-1

FileName : G:\GC04\B\026J011.raw
Start Time : 0.00 min
Scale Factor: -1

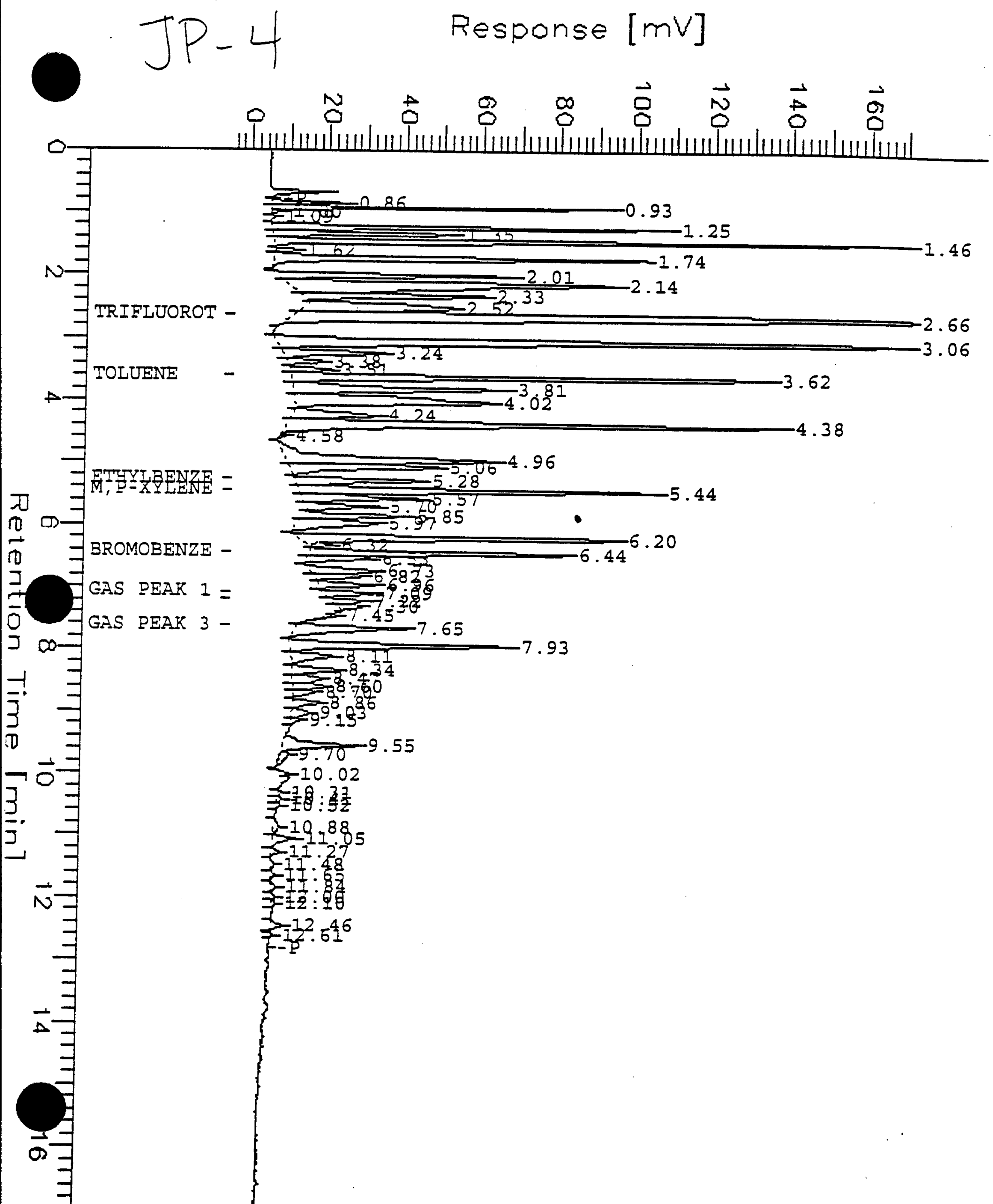
End Time : 17.00 min
Plot Offset: -4 mV

Date : 2/1/95 3:57 PM
Low Point : -4.15 mV
Plot Scale: 175 mV



High Point : 170.85 mV

JP-4



## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124833-001 | BE-MP10-01 | 26672 | 03/13/96 | 03/28/96 | 03/28/96 | |
| 124833-002 | BE-MP12-01 | 26672 | 03/13/96 | 03/28/96 | 03/28/96 | |
| 124833-003 | BE-MP13-01 | 26672 | 03/13/96 | 03/28/96 | 03/28/96 | |
| 124833-004 | BE-MP47-01 | 26672 | 03/13/96 | 03/28/96 | 03/28/96 | |

| Analyte<br>Diln Fac: | Units | 124833-001<br>1 | 124833-002<br>1 | 124833-003<br>10 | 124833-004<br>1 |
|---|---|---|---|---|---|
| Benzene | ug/L | <0.5 | <0.5 | <5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 | <5 | <0.5 |
| Ethylbenzene | ug/L | 18 | <0.5 | 5.5C | <0.5 |
| m,p-Xylenes | ug/L | 14 | <0.5 | 12 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 | <5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | 14 | <0.5 | 37 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | 20 | <0.5 | 54 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | 16 C | <0.5 | 31 C | <0.5 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 102 | 95 | 98 | 96 |
| Bromobenzene | %REC | 103 | 89 | 93 | 91 |

C: Presence of this compound confirmed by second column, however, the confirmation concentration differed from the reported result by more than a factor of two

Curtis & Tompkins, Ltd


BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124833-005 | TRIP BLANK | 26672 | 03/13/96 | 03/27/96 | 03/27/96 | |

| Analyte | Units | 124833-005 |
|---|---|---|
| Diln Fac: | | 1 |
| Benzene | ug/L | <0.5 |
| Toluene | ug/L | <0.5 |
| Ethylbenzene | ug/L | <0.5 |
| m,p-Xylenes | ug/L | <0.5 |
| o-Xylene | ug/L | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 |
| **Surrogate** | | |
| Trifluorotoluene | %REC | 99 |
| Bromobenzene | %REC | 89 |

Curtis & Tompkins, Ltd

Lab #: 124833

BATCH QC REPORT



BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/27/96 |
| Batch#: 26672 | Analysis Date: 03/27/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC18055

| Analyte | Result | |
|---|---|---|
| Benzene | <0.5 | |
| Toluene | <0.5 | |
| Ethylbenzene | <0.5 | |
| m,p-Xylenes | <0.5 | |
| o-Xylene | <0.5 | |
| 1,2,3-Trimethylbenzene | <0.5 | |
| 1,2,4-Trimethylbenzene | <0.5 | |
| 1,3,5-Trimethylbenzene | <0.5 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 94 | 58-130 |
| Bromobenzene | 81 | 62-131 |

Curtis & Tompkins, Ltd

Lab #: 124833 BATCH QC REPORT 

BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26672
Units: ug/L
Diln Fac: 1

Prep Date: 03/27/96
Analysis Date: 03/27/96

LCS Lab ID: QC18057

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 16.8 | 20 | 84 | 80-120 |
| Toluene | 17.7 | 20 | 89 | 80-120 |
| Ethylbenzene | 16.2 | 20 | 81 | 80-120 |
| m,p-Xylenes | 36.8 | 40 | 92 | 80-120 |
| o-Xylene | 17.5 | 20 | 88 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 96 | 58-130 |
| Bromobenzene | 81 | 62-131 |

Column to be used to flag recovery and RPD values with an asterisk
Values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

# CURTIS & TOMPKINS, LTD. BERKELEY LOGIN CHANGE FORM

Reason for change: ✓ Client Request: By: Michael Phelps Date/Time: 3/18/96 Initials: TM
_____ Login Review _____ Data Review

| Current Lab ID | Previous Lab ID | Client ID | Matrix | Add/Cancel | Analysis | Duedate |
|---|---|---|---|---|---|---|
| 124833-5 | | TRIP BLANK | $H_2O$ | Add | TVH/B/TMB | 3/27 |

Curtis & Tompkins, Ltd.

PARSONS ENGINEERING SCIENCE, INC.
1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020

Project Name/Location: Beale AFB, UST Site

Project Manager: Todd Wiedemeier (Denver, CO)

Site Manager: Michael Phelps (Alameda, CA)

Sampler(s): (Initials and Signature(s))
AFE [signature]
MHF [signature]

6°C

Note: All analyses and holding times according to AFCEE handbook requirements.

| Sample ID | Date | Time | Begin Depth | End Depth | Matrix | No. of Containers | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see note 1 | BTEX and TMBs (5030/8020) see notes 1, 2 | Halogenated VOCs (5030/8010) see notes 1,4 | SVOCs (3550/8270) see note 1 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP10-01 | 3/13/96 | 0935 | – | – | water | 4 | X | X | X | | | |
| BE-MP12-01 | 3/13/96 | 1015 | – | – | water | 4 | X | X | X | | | No Liter Amber for TEH arrived |
| BE-MP13-01 | 3/13/96 | 1155 | – | – | water | 4 | X | X | X | | | 2 VOA's arrived broken |
| BE-MP47-01 | 3/13/96 | 1110 | – | – | water | 3 | X | | X | | | |
| | | | | | water | | | | | | | |
| Trip blank | | | | | water | | * | | * | | | * Run per MP. 5/18 |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |
| | | | | | water | | | | | | | |

ORGANICS / INORGANICS / OTHER

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) | NOTES: |
|---|---|---|---|---|
| | | | | 1. Secondary column confirmation required. 2. Quantify all carbon ranges: diesel, jet fuel, oil/grease. 3. Deionized water extraction. 4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene. |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LAB BY: (SIGNATURE) | DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|---|---|---|---|
| [signature] | 3/13/96 | 1400 | Teresa Morris | 3/14/96 | | |

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples.

Beale

# COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login#: 124833 Date Received: 3/14/96 Number of Coolers: 1
Client: Parsons E.S. Project: Beale AFB

A. Preliminary Examination Phase
Date Opened: 3/14/96 By (print): ~~T. Morrison~~ (sign) → T. MORRISON

1. Did cooler come with a shipping slip (airbill, etc.)? .......... YES NO
If YES, enter carrier name and airbill number: FED EX 115 409 2156
2. Were custody seals on outside of cooler? .......... YES NO
How many and where? 1 Front / 1 Back Seal date: 3/13 Seal name: H. Sichler
3. Were custody seals unbroken and intact at the date and time of arrival? .......... YES NO
4. Were custody papers dry and intact when received? .......... YES NO
5. Were custody papers filled out properly (ink, signed, etc.)? .......... YES NO
6. Did you sign the custody papers in the appropriate place? .......... YES NO
7. Was project identifiable from custody papers? .......... YES NO
If YES, enter project name at the top of this form.
8. If required, was sufficient ice used? .......... YES NO
Type of ice: WET Temperature: 6°C

B. Login Phase
Date Logged In: 3/15 By (print): JWH (sign) [illegible]

1. Describe type of packing in cooler: ?
2. Did all bottles arrive unbroken? .......... YES NO
3. Were labels in good condition and complete (ID, date, time, signature, etc.)? .......... YES NO
4. Did bottle labels agree with custody papers? .......... YES NO
5. Were appropriate containers used for the tests indicated? .......... YES NO
6. Were correct preservatives added to samples? .......... YES NO
7. Was sufficient amount of sample sent for tests indicated? .......... YES NO
8. Were bubbles absent in VOA samples? If NO, list sample Ids below .......... YES NO
9. Was the client contacted concerning this sample delivery? .......... YES NO
If YES, give details below.
Who was called? ______ By whom? ______ Date: ______

Additional Comments:
2 only 1 VOA vial rec'd intact for BE-MP013-01
* No Liter Amber submitted for TEH sample BEMP12-01 - Jow 3/15
Trip blank received logged on the COC 3/15
Not on COC

Filename: F:\qc\forms\cooler.wpd Rev. 1 4/95

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# ANALYTICAL REPORT

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 02-APR-96
Lab Job Number: 124895
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Teresa K Morrison

Reviewed by: _______________

Curtis & Tompkins, Ltd

**Laboratory Number: 124895**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 03/20/96**
**Receipt Date:03/20/96**

## CASE NARRATIVE

This hardcopy data package contains sample results and batch QC for one trip blank, one water sample and one composite soil sample received from the above referenced project on March 20, 1996. All samples were received cold and intact. The trip blank was not documented on the chain-of-custody. Per the client request, the trip blank was analyzed for TPH/gasoline and BTXE/TMBs.

**TPH/Extractable:** No analytical problems were encountered.

**TPH/Purgeable:** No analytical problems were encountered.

**BTXE (EPA 8020):** No analytical problems were encountered.

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## TEH-Tot Ext Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | EPA 3520 |
| Location: | Beale AFB | | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124895-001 | BE-IDW-01 | 26564 | 03/20/96 | 03/21/96 | 03/25/96 | |

| Analyte | Units | 124895-001 | |
|---|---|---|---|
| Diln Fac: | | 1 | |
| JP5 | ug/L | 780 | YH |
| Diesel Range | ug/L | 1100 | YLH |
| Motor Oil Range | ug/L | 460 | YL |
| **Surrogate** | | | |
| Hexacosane | %REC | 88 | |

Y: Sample exhibits fuel pattern which does not resemble standard
H: Heavier hydrocarbons than indicated standard
L: Lighter hydrocarbons than indicated standard

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## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: LUFT

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124895-007 | COMP IDW-(2,3,4,5,6) | 26567 | 03/20/96 | 03/21/96 | 03/27/96 | 17% |

| Analyte<br>Diln Fac: | Units | 124895-007<br>1 |
|---|---|---|
| JP5 | mg/Kg | 3.1YH |
| Diesel Range | mg/Kg | 17 YH |
| Motor Oil Range | mg/Kg | 110 YH |
| Surrogate | | |
| Hexacosane | %REC | 109 |

Y: Sample exhibits fuel pattern which does not resemble standard
H: Heavier hydrocarbons than indicated standard

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## TEH-Tot Ext Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 3520 |
| Location: Beale AFB | |

## METHOD BLANK

| | |
|---|---|
| Matrix: Water | Prep Date: 03/21/96 |
| Batch#: 26564 | Analysis Date: 03/25/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC17632

| Analyte | Result | |
|---|---|---|
| JP5 | <50 | |
| Diesel Range | <50 | |
| Motor Oil Range | <300 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 99 | 60-140 |

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## TEH-Tot Ext Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M |
| Project#: 722450.14020 | Prep Method: LUFT |
| Location: Beale AFB | |

## METHOD BLANK

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/21/96 |
| Batch#: 26567 | Analysis Date: 03/25/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

MB Lab ID: QC17643

| Analyte | Result | |
|---|---|---|
| JP5 | <1.0 | |
| Diesel Range | <1.0 | |
| Motor Oil Range | <5.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 139 | 60-140 |

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## TEH-Tot Ext Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | EPA 3520 |
| Location: | Beale AFB | | |

## BLANK SPIKE/BLANK SPIKE DUPLICATE

| | | | |
|---|---|---|---|
| Matrix: | Water | Prep Date: | 03/21/96 |
| Batch#: | 26564 | Analysis Date: | 03/25/96 |
| Units: | ug/L | | |
| Diln Fac: | 1 | | |

BS Lab ID: QC17633

| Analyte | Spike Added | BS | %Rec | # | Limits |
|---|---|---|---|---|---|
| Diesel Range | 2475 | 2265 | 92 | | 60-140 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 90 | 60-140 |

BSD Lab ID: QC17634

| Analyte | Spike Added | BSD | %Rec | # | Limits | RPD | # | Limit |
|---|---|---|---|---|---|---|---|---|
| Diesel Range | 2475 | 2355 | 95 | | 60-140 | 4 | | <35 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 88 | 60-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

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| TEH-Tot Ext Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: LUFT |
| Location: Beale AFB | |

## LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/21/96 |
| Batch#: 26567 | Analysis Date: 03/25/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

LCS Lab ID: QC17644

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Diesel Range | 55.4 | 49.5 | 112 | 60-140 |
| **Surrogate** | **%Rec** | **Limits** | | |
| Hexacosane | 125 | 60-140 | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

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Lab #: 124895 | BATCH QC REPORT | 

## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: LUFT

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: COMP IDW-(2,3,4,5,6)
Lab ID: 124895-007
Matrix: Soil
Batch#: 26567
Units: mg/Kg dry weight
Diln Fac: 1

Sample Date: 03/20/96
Received Date: 03/20/96
Prep Date: 03/21/96
Analysis Date: 03/25/96
Moisture: 17%

MS Lab ID: QC17645

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Diesel Range | 59.64 | 16.87 | 62.89 | 77 | 60-140 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 132 | 60-140 |

MSD Lab ID: QC17646

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Diesel Range | 59.64 | 57.47 | 68 | 60-140 | 13 | <30 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Hexacosane | 120 | 60-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

# GC15 Channel A TEH

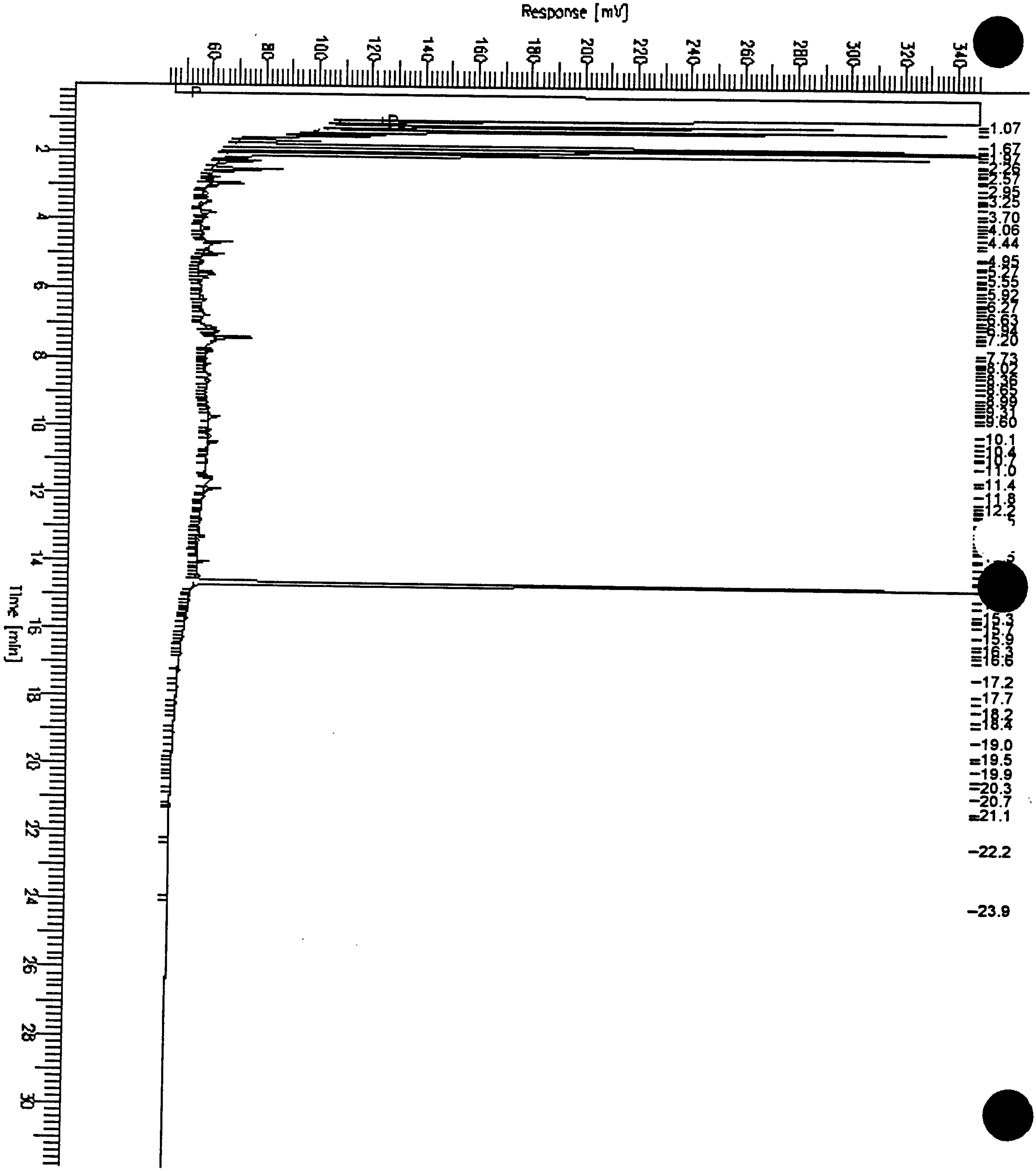
Sample Name : S,124895-001,26564
FileName : C:\GC15\CHB\084B015.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0

End Time : 31.91 min
Plot Offset: 43 mV

Sample #: 500:2.5
Date : 3/26/96 02:48 PM
Time of Injection: 3/25/96 08:24 AM
Low Point : 42.54 mV
Plot Scale: 305.8 mV



High Point : 348.33 mV



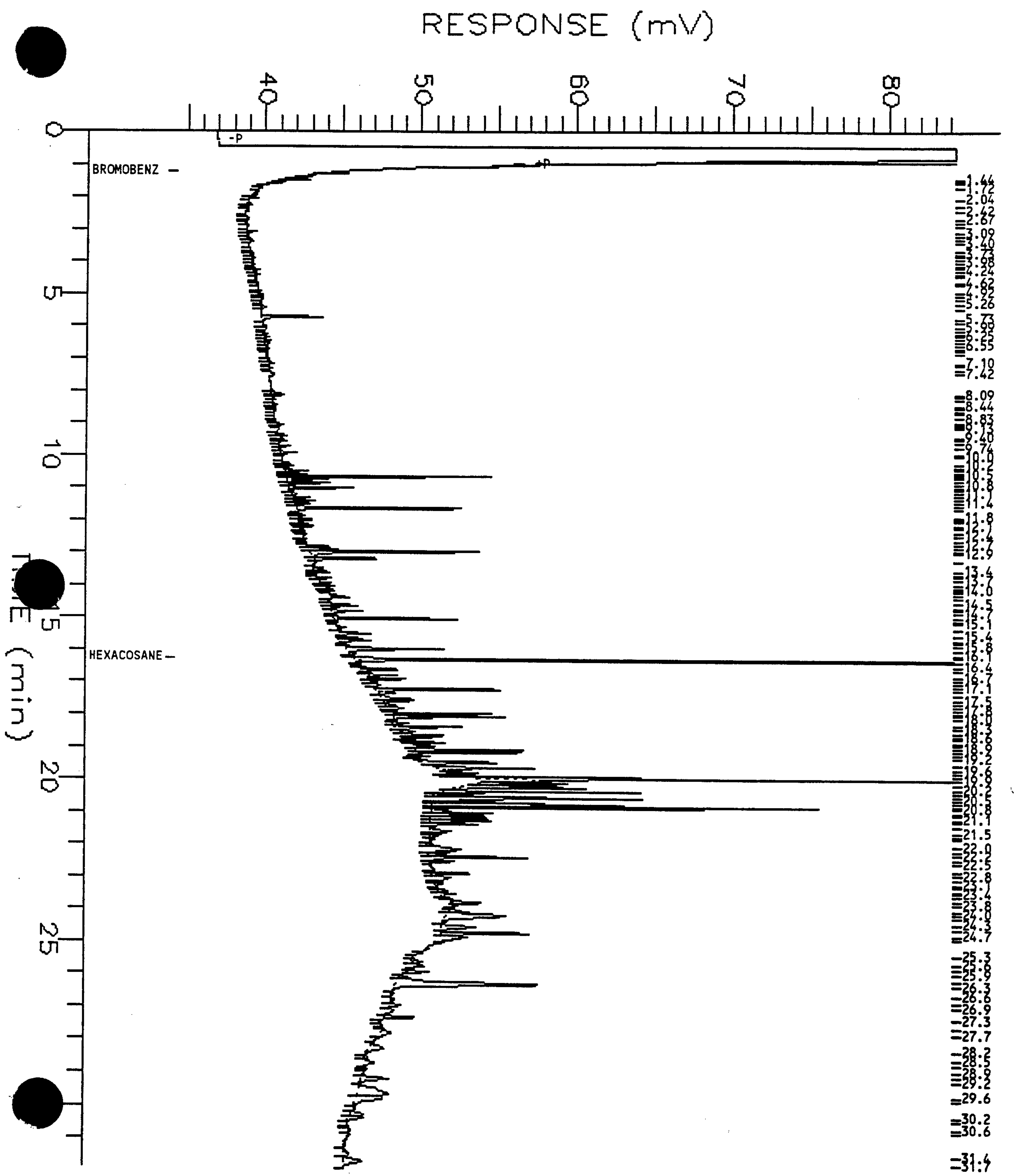
TEH Chromatogram-GC13 CH A

Sample Name : 124895-007,50:5
FileName : g:\gc13\cha\087A021.raw
Method : 13DUAL32.ins
Start Time : 0.00 min
Scale Factor: -1
End Time : 31.92 min
Plot Offset: 34 mV

Sample #: 26567
Date : 3/27/96 09:51 PM
Time of Injection: 3/27/96 09:17 PM
Low Point : 34.32 mV
Plot Scale: 50 mV



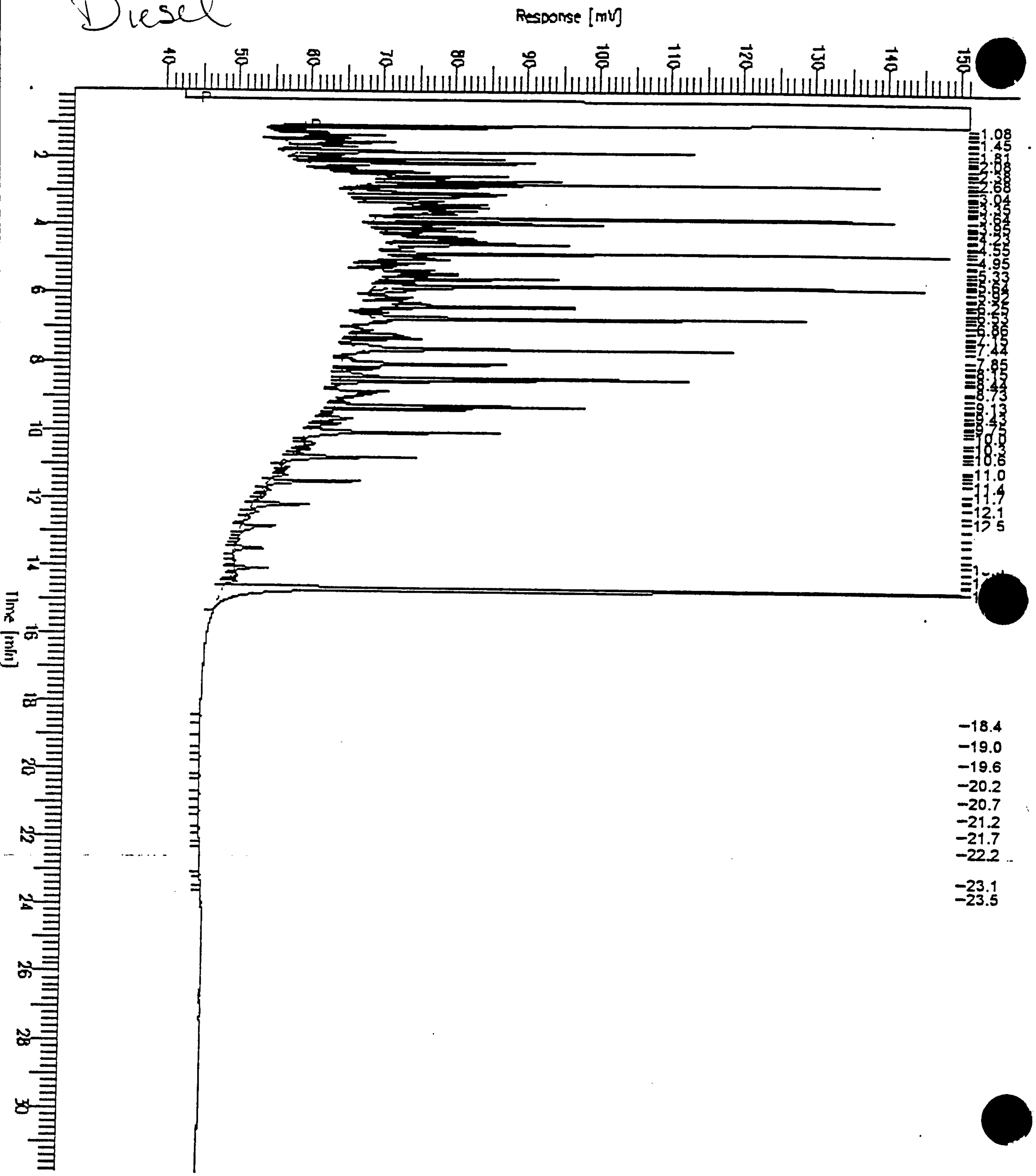
High Point : 84.32 mV



Sample Name : CCV,96WS1948,DSL
FileName : C:\GC15\CHB\084B039.RAW
Method : BTEH.MTH
Start Time : 0.01 min    End Time : 31.91 min
Scale Factor: 0.0    Plot Offset: 40 mV

Sample #: 500MG/L    Page 1 of 1
Date : 3/26/96 12:58 PM
Time of Injection: 3/26/96 12:04 AM
Low Point : 39.68 mV    High Point : 151.11 mV
Plot Scale: 111.4 mV

Diesel

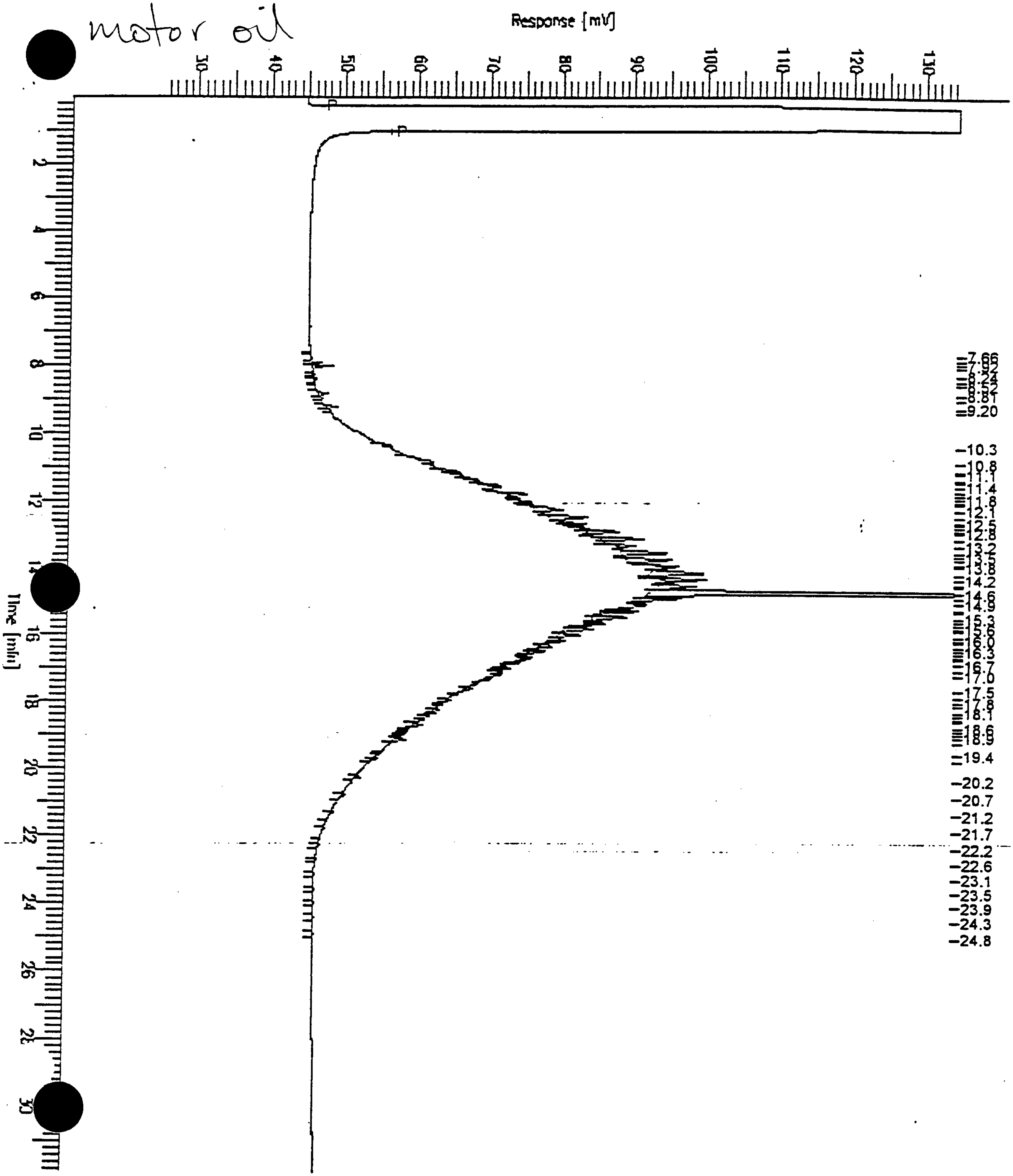


Sample Name : CCV,96WS2112,MO
FileName : C:\GC15\CHB\084B042.RAW
Method : BTEH.MTH
Start Time : 0.01 min End Time : 31.91 min
Scale Factor: 0.0 Plot Offset: 25 mV

Sample #: 500MG/L
Date : 3/26/96 12:55 PM
Time of Injection: 3/26/96 02:17 AM
Low Point : 25.07 mV High Point : 134.45 mV
Plot Scale: 109.4 mV



motor oil

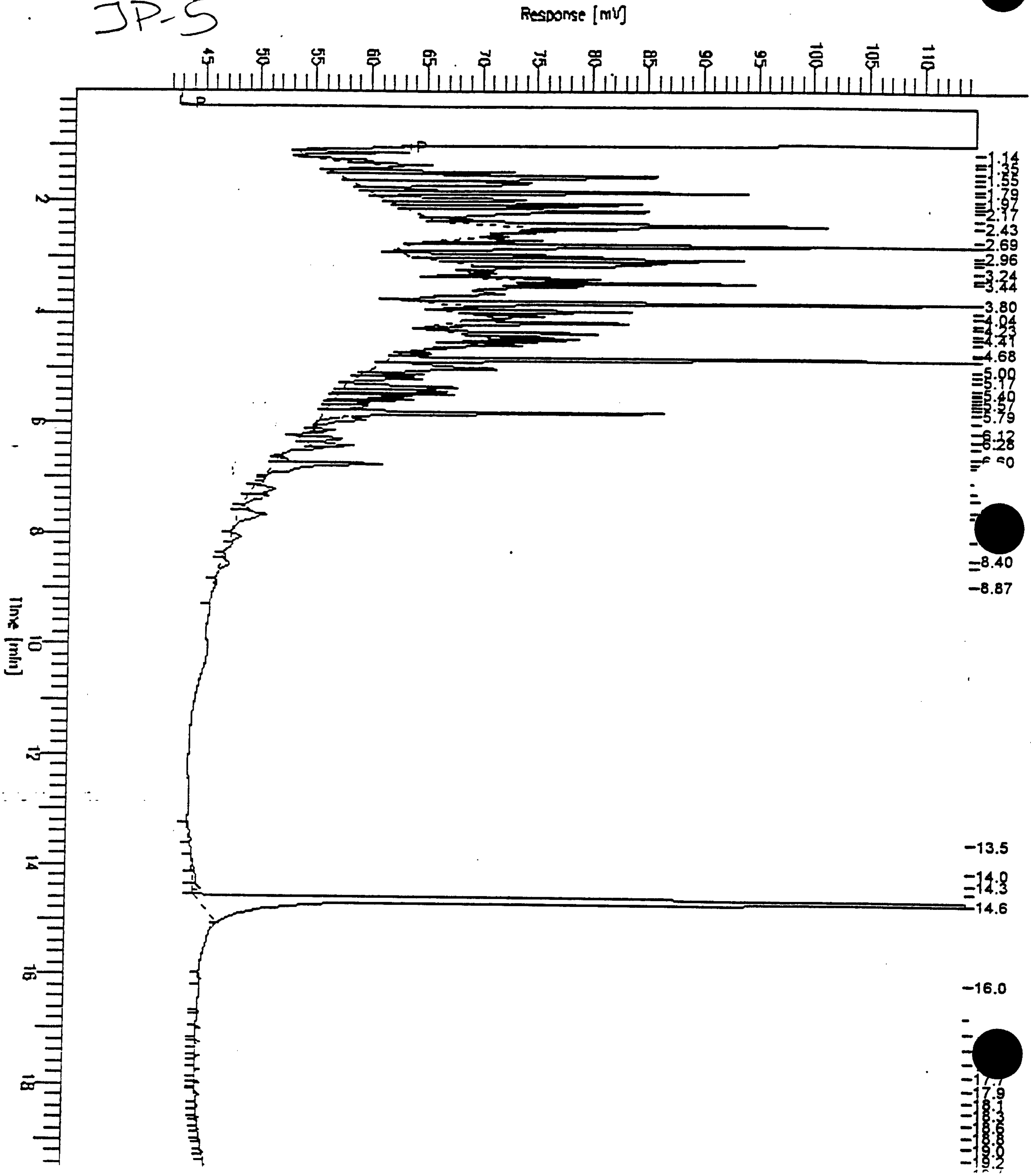


# GC15 Channel A TEH

Sample Name : CCV,96WS2069,JP5
FileName : C:\GC15\CHB\084B023.RAW
Method : BTEH.MTH
Start Time : 0.01 min End Time : 19.80 min
Scale Factor: 0.0 Plot Offset: 42 mV

Sample #: 250MG/L Page 1 of 1
Date : 3/26/96 12:54 PM
Time of Injection: 3/25/96 01:29 PM
Low Point : 41.54 mV High Point : 114.59 mV
Plot Scale: 73.1 mV

JP-5



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## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124895-001 | BE-IDW-01 | 26672 | 03/20/96 | 03/28/96 | 03/28/96 | |
| 124895-008 | TRIP BLANK | 26672 | 03/20/96 | 03/27/96 | 03/27/96 | |

| Analyte | Units | 124895-001 | 124895-008 |
|---|---|---|---|
| Diln Fac: | | 1 | 1 |
| Gasoline | ug/L | <50 | <50 |
| Surrogate | | | |
| Trifluorotoluene | %REC | 98 | 96 |
| Bromobenzene | %REC | 101 | 94 |

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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124895-007 | COMP IDW-(2,3,4,5,6) | 26608 | 03/20/96 | 03/25/96 | 03/25/96 | 17% |

| Analyte<br>Diln Fac: | Units | 124895-007<br>1 |
|---|---|---|
| Gasoline | mg/Kg | <1.2 |
| Surrogate | | |
| Trifluorotoluene | %REC | 98 |
| Bromobenzene | %REC | 82 |

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Lab #: 124895 BATCH QC REPORT 

| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: CA LUFT (EPA 8015M)<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Soil<br>Batch#: 26608<br>Units: mg/Kg<br>Diln Fac: 1 | Prep Date: 03/25/96<br>Analysis Date: 03/25/96 |

MB Lab ID: QC17798

| Analyte | Result | |
|---|---|---|
| Gasoline | <1.0 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 95 | 52-127 |
| Bromobenzene | 77 | 47-112 |

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Lab #: 124895

BATCH QC REPORT



| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: CA LUFT (EPA 8015M<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Water<br>Batch#: 26672<br>Units: ug/L<br>Diln Fac: 1 | Prep Date: 03/27/96<br>Analysis Date: 03/27/96 |

MB Lab ID: QC18055

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 95 | 69-120 |
| Bromobenzene | 87 | 70-122 |

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## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/25/96 |
| Batch#: 26608 | Analysis Date: 03/25/96 |
| Units: mg/Kg | |
| Diln Fac: 1 | |

LCS Lab ID: QC17799

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 9.6 | 10 | 96 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 112 | 52-127 |
| Bromobenzene | 92 | 47-112 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

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Lab #: 124895 BATCH QC REPORT 

TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Water | Prep Date: 03/27/96 |
| Batch#: 26672 | Analysis Date: 03/27/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

LCS Lab ID: QC18056

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 1843 | 2006 | 92 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 103 | 69-120 |
| Bromobenzene | 101 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

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## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 124797-006
Matrix: Water
Batch#: 26672
Units: ug/L
Diln Fac: 1

Sample Date: 03/12/96
Received Date: 03/13/96
Prep Date: 03/27/96
Analysis Date: 03/27/96

MS Lab ID: QC18058

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 2000 | <50.00 | 2047 | 102 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 104 | 69-120 |
| Bromobenzene | 110 | 70-122 |

MSD Lab ID: QC18059

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 2000 | 2135 | 107 | 75-125 | 4 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 104 | 69-120 |
| Bromobenzene | 114 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

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## BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124895-001 | BE-IDW-01 | 26672 | 03/20/96 | 03/28/96 | 03/28/96 | |
| 124895-008 | TRIP BLANK | 26672 | 03/20/96 | 03/27/96 | 03/27/96 | |

| Analyte | Units | 124895-001 | 124895-008 |
|---|---|---|---|
| Diln Fac: | | 1 | 1 |
| Benzene | ug/L | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 |
| Ethylbenzene | ug/L | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | <0.5 |
| **Surrogate** | | | |
| Trifluorotoluene | %REC | 98 | 95 |
| Bromobenzene | %REC | 94 | 87 |

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## BTXE

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124895-007 | COMP IDW-(2,3,4,5,6) | 26608 | 03/20/96 | 03/25/96 | 03/25/96 | 17% |

| Analyte<br>Diln Fac: | Units | 124895-007<br>1 |
|---|---|---|
| Benzene | ug/Kg | <6 |
| Toluene | ug/Kg | <6 |
| Ethylbenzene | ug/Kg | <6 |
| m,p-Xylenes | ug/Kg | <6 |
| o-Xylene | ug/Kg | <6 |
| 1,2,3-Trimethylbenzene | ug/Kg | <6 |
| 1,2,4-Trimethylbenzene | ug/Kg | <6 |
| 1,3,5-Trimethylbenzene | ug/Kg | <6 |
| **Surrogate** | | |
| Trifluorotoluene | %REC | 100 |
| Bromobenzene | %REC | 97 |

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BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

METHOD BLANK

| | |
|---|---|
| Matrix: Soil | Prep Date: 03/25/96 |
| Batch#: 26608 | Analysis Date: 03/25/96 |
| Units: ug/Kg | |
| Diln Fac: 1 | |

MB Lab ID: QC17798

| Analyte | Result |
|---|---|
| Benzene | <5.0 |
| Toluene | <5.0 |
| Ethylbenzene | <5.0 |
| m,p-Xylenes | <5.0 |
| o-Xylene | <5.0 |
| 1,2,3-Trimethylbenzene | <5.0 |
| 1,2,4-Trimethylbenzene | <5.0 |
| 1,3,5-Trimethylbenzene | <5.0 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| Trifluorotoluene | 99 | 43-114 |
| Bromobenzene | 94 | 45-140 |

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Lab #: 124895 BATCH QC REPORT 

| BTXE | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: EPA 8020<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Water<br>Batch#: 26672<br>Units: ug/L<br>Diln Fac: 1 | Prep Date: 03/27/96<br>Analysis Date: 03/27/96 |

MB Lab ID: QC18055

| Analyte | Result | |
|---|---|---|
| Benzene | <0.5 | |
| Toluene | <0.5 | |
| Ethylbenzene | <0.5 | |
| m,p-Xylenes | <0.5 | |
| o-Xylene | <0.5 | |
| 1,2,3-Trimethylbenzene | <0.5 | |
| 1,2,4-Trimethylbenzene | <0.5 | |
| 1,3,5-Trimethylbenzene | <0.5 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 94 | 58-130 |
| Bromobenzene | 81 | 62-131 |

Lab #: 124895

BATCH QC REPORT



BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Soil
Batch#: 26608
Units: ug/Kg
Diln Fac: 1

Prep Date: 03/25/96
Analysis Date: 03/25/96

LCS Lab ID: QC17800

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 97 | 100 | 97 | 80-120 |
| Toluene | 101 | 100 | 101 | 80-120 |
| Ethylbenzene | 99 | 100 | 99 | 80-120 |
| m,p-Xylenes | 200 | 200 | 100 | 80-120 |
| o-Xylene | 103 | 100 | 103 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 100 | 43-114 |
| Bromobenzene | 95 | 45-140 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 3 out of 8 outside limits

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**BTXE**

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

**LABORATORY CONTROL SAMPLE**

| | |
|---|---|
| Matrix: Water | Prep Date: 03/27/96 |
| Batch#: 26672 | Analysis Date: 03/27/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

LCS Lab ID: QC18057

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 16.8 | 20 | 84 | 80-120 |
| Toluene | 17.7 | 20 | 89 | 80-120 |
| Ethylbenzene | 16.2 | 20 | 81 | 80-120 |
| m,p-Xylenes | 36.8 | 40 | 92 | 80-120 |
| o-Xylene | 17.5 | 20 | 88 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 96 | 58-130 |
| Bromobenzene | 81 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 8 outside limits

124895

# CHAIN OF CUSTODY FORM

Curtis & Tompkins, Ltd.
Analytical Laboratories, Since 1878
2323 Fifth Street
Berkeley, CA 94710
(510) 486-0900 Phone
(510) 486-0532 Fax

Page ____ of ____

C&T LOGIN # ____

Project No: 722450.14020

Project Name: Beale Intrinsic

Project P.O.: 722450.14020

Turnaround Time: Std.

Sampler: H. Eichler

Report To: Michael Phelps

Company: Parsons ES

Telephone: 510 769 0100

Fax: 510 769 9244

| Lab Number | Sample ID. | Sampling Date Time | Matrix: Soil | Matrix: Water | Matrix: Waste | # of Containers | Preservative: HCl | Preservative: $H_2SO_4$ | Preservative: $HNO_3$ | Preservative: ICE | Field Notes | Analyses: TPH-g | Analyses: TPH-d | Analyses: BTEX, TMBs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BE-1DW-01 | 3/20/96 1000 | | X | | 4 | | | | | | | | |
| | BE-1DW-02 | 0815 | X | | | 1 | | | | | | X | X | X |
| | BE-1DW-03 | | X | | | 1 | | | | | COMPOSITE ALL | X | X | X |
| | BE-1DW-04 | | X | | | 1 | | | | | 5 FOR | X | X | X |
| | BE-1DW-05 | | X | | | 1 | | | | | ONE | X | X | X |
| | BE-1DW-06 | | X | | | 1 | | | | | ANALYSIS | X | X | X |
| | comp | | | | | | | | | | | X | X | X |
| | | | | | | | | | | | | | | |
| | Trip blank | | | | | | | | | | | | | |
| | | | | | | | | | | | logged in Hold - 3/20/96 | | | |

Notes:

RELINQUISHED BY:

DATE/TIME

DATE/TIME

3/20/96 1600 DATE/TIME

RECEIVED BY:

DATE/TIME

DATE/TIME

3-20-96 16[illegible] DATE/TIME

Signature on this form constitutes a firm Purchase Order for the services requested above.

# CURTIS & TOMPKINS, LTD. BERKELEY    LOGIN CHANGE FORM

Reason for change: standing request Client Request: By: M. Phelps Date/Time: 3/21/96 Initials: TK

_______ Login Review _______ Data Review

| Current Lab ID | Previous Lab ID | Client ID | Matrix | Add/Cancel | Analysis | Duedate |
|---|---|---|---|---|---|---|
| | | | | | | |
| 124895-8 | | TRIP BLANK | $H_2O$ | Add | TVH/B/TMB | |
| | | | | | | |
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Curtis & Tompkins, Ltd.

Beale

Curtis & Tompkins, Ltd.

# COOLER RECEIPT CHECKLIST

Login#: 124895 Date Received: 3/20 Number of Coolers: 1
Client: ES Project: Beale

A. Preliminary Examination Phase
Date Opened: 3/20 By (print): J.Wilk (sign) [signature]

1. Did cooler come with a shipping slip (airbill, etc.)?............by hand........... YES NO
If YES, enter carrier name and airbill number:
2. Were custody seals on outside of cooler?........................................................ YES NO
How many and where? Seal date: Seal name:
3. Were custody seals unbroken and intact at the date and time of arrival?.......... YES NO ✓ / [illegible]
4. Were custody papers dry and intact when received?.......................................... YES NO
5. Were custody papers filled out properly (ink, signed, etc.)?.............................. YES NO
6. Did you sign the custody papers in the appropriate place?................................ YES NO
7. Was project identifiable from custody papers?.................................................. YES NO
If YES, enter project name at the top of this form.
8. If required, was sufficient ice used?.................................................................. YES NO
Type of ice: cube / blue Temperature: 4.75°C

B. Login Phase
Date Logged In: 3/20 By (print): J.Williams (sign) [signature]

1. Describe type of packing in cooler: bubble wrap
2. Did all bottles arrive unbroken?...................................................................... YES NO
3. Were labels in good condition and complete (ID, date, time, signature, etc.)?... YES NO
* 4. Did bottle labels agree with custody papers?.................................................. YES NO jaw
5. Were appropriate containers used for the tests indicated?................................ YES NO
6. Were correct preservatives added to samples?................................................. YES NO
7. Was sufficient amount of sample sent for tests indicated?................................. YES NO
8. Were bubbles absent in VOA samples? If NO, list sample Ids below................. YES NO
9. Was the client contacted concerning this sample delivery?................................ YES NO
If YES, give details below.
Who was called? By whom? Date:

Additional Comments:
* Trip blank received / not on C-o-C - logged on hold jaw 3/20/[illegible]

Filename: F:\qc\forms\cooler.wpd Rev. 1 4/95

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

# ANALYTICAL REPORT

Prepared for:

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Date: 02-APR-96
Lab Job Number: 124848
Project ID: 722450.14020
Location: Beale AFB

Reviewed by: Tresa K Morris

Reviewed by: [illegible]

This package may be reproduced only in its entirety.

Curtis & Tompkins, Ltd

**Laboratory Number: 124848**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 03/15/96**
**Receipt Date: 03/15/96**

## CASE NARRATIVE

This hardcopy data package contains sample results and batch QC for four water samples received from the above referenced project on March 15, 1996. All samples were received cold and intact.

**TPH/Extractable:** No analytical problems were encountered.

**TPH/Purgeable:** No analytical problems were encountered.

**BTXE (EPA 8020):** No analytical problems were encountered.

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## TEH-Tot Ext Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 3520

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124848-001 | BE-SW01-01 | 26513 | 03/15/96 | 03/19/96 | 03/22/96 | |
| 124848-002 | BE-SW02-01 | 26513 | 03/15/96 | 03/19/96 | 03/22/96 | |
| 124848-003 | BE-SW12-01 | 26513 | 03/15/96 | 03/19/96 | 03/22/96 | |
| 124848-004 | BE-SW03-01 | 26513 | 03/15/96 | 03/19/96 | 03/22/96 | |

| Analyte | Units | 124848-001 | 124848-002 | 124848-003 | 124848-004 |
|---|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | 1 | 1 |
| JP5 | ug/L | <50 | <50 | <50 | <50 |
| Diesel Range | ug/L | <50 | 140 Y | 120 Y | <50 |
| Motor Oil Range | ug/L | <300 | <300 | <300 | <300 |
| **Surrogate** | | | | | |
| Hexacosane | %REC | 104 | 127 | 120 | 108 |

Y: Sample exhibits fuel pattern which does not resemble standard

Curtis & Tompkins, Ltd



| TEH-Tot Ext Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 3520 |
| Location: Beale AFB | |

| METHOD BLANK | |
|---|---|
| Matrix: Water | Prep Date: 03/19/96 |
| Batch#: 26513 | Analysis Date: 03/21/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC17466

| Analyte | Result | |
|---|---|---|
| JP5 | <50 | |
| Diesel Range | <50 | |
| Motor Oil Range | <300 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Hexacosane | 103 | 60-140 |

# EVERGREEN ANALYTICAL, Inc.

4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : 3/15/96 | | Client Project ID. | : | 722450.14020 |
| Date Received | : 3/16/96 | | Lab Project Number | : | 96-0805 |
| Date Prepared | : 3/16/96 | | Method | : | EPA 300.0 |
| Date Analyzed | : 3/16/96 | | Detection Limit | : | 0.056 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrate-N mg/L | Dilution Factor |
|---|---|---|---|---|
| X20559 | BE-SW01-01 | Water | 0.15 | 1 |
| X20560 | BE-SW02-01 | Water | 0.12 | 1 |
| X20561 | BE-SW03-01 | Water | 0.17 | 1 |
| Method Blank | (3/16/96) | | <0.056 | |

### Quality Assurance *

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20559 | BE-SW01-01 Matrix Spike | 10.0 | 0.65 | 10.0 | 94 |
| X20559 | BE-SW01-01 Matrix Spike Dup | 10.0 | 0.65 | 9.9 | 92 |
| MS/MSD RPD | | | | | 1.6 |

* = Quality assurance results reported as Nitrate ($NO_3$).

Analyst

Approved

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/15/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/16/96 | Lab Project Number | : | 96-0805 |
| Date Prepared | : | 3/16/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/16/96 | Detection Limit | : | 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Sulfate mg/L | Dilution Factor |
|---|---|---|---|---|
| X20559 | BE-SW01-01 | Water | 1.6 | 1 |
| X20560 | BE-SW02-01 | Water | 9.9 | 1 |
| X20561 | BE-SW03-01 | Water | 2.1 | 1 |
| Method Blank | (3/16/96) | | <0.25 | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20559 | BE-SW01-01 Matrix Spike | 10.0 | 1.6 | 10.9 | 94 |
| X20559 | BE-SW01-01 Matrix Spike Dup | 10.0 | 1.6 | 11.2 | 97 |
| MS/MSD RPD | | | | | 3.1 |

Analyst

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/15/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/16/96 | Lab Project Number | : | 96-0805 |
| Date Prepared | : | 3/16/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/16/96 | Detection Limit | : | 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Chloride mg/L | Dilution Factor |
|---|---|---|---|---|
| X20559 | BE-SW01-01 | Water | 2.3 | 1 |
| X20560 | BE-SW02-01 | Water | 33 | 5 |
| X20561 | BE-SW03-01 | Water | 5.1 | 1 |
| Method Blank | (3/16/96) | | <0.25 | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20559 | BE-SW01-01 Matrix Spike | 10.0 | 2.3 | 12.3 | 100 |
| X20559 | BE-SW01-01 Matrix Spike Dup | 10.0 | 2.3 | 14.3 | 120 |
| MS/MSD RPD | | | | | 18 |

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(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/15/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/16/96 | Lab Project Number | : | 96-0805 |
| Date Prepared | : | 3/16/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/16/96 | Detection Limit | : | 0.076 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrite-N mg/L | Dilution Factor |
|---|---|---|---|---|
| X20559 | BE-SW01-01 | Water | <0.076 | 1 |
| X20560 | BE-SW02-01 | Water | <0.076 | 1 |
| X20561 | BE-SW03-01 | Water | <0.076 | 1 |
| Method Blank | (3/16/96) | | <0.076 | |

### Quality Assurance *

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20559 | BE-SW01-01 Matrix Spike | 10.0 | <0.25 | 10.1 | 101 |
| X20559 | BE-SW01-01 Matrix Spike Dup | 10.0 | <0.25 | 9.6 | 96 |
| MS/MSD RPD | | | | | 5.5 |

* = Quality assurance results reported as Nitrite ($NO_2$).

Analyst

Approved

Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3/16/96 0927 Shipped Via: FDX-070109 1495
(Airbill # if applicable)

Client : PARSON E S

Client Project ID(s): ____

EAL Project #(s): 96-0805 EAL Cooler(s): Y N

Cooler# PARSONS

Ice packs Y N Y N Y N Y N Y N

Temperature °C 3

0701091495

| | Y | N | N/A |
|---|---|---|---|
| 1. Custody seal(s) present: | | | |
| Seals on cooler intact | X | | |
| Seals on bottle intact | | | |
| 2. Chain of Custody present: | X | | |
| 3. Samples Radioactive: (Comment on COC if >0.5mr/h) | | ✓ | |
| 4. Containers broken or leaking: (Comment on COC if Y) | | X | |
| 5. Containers labeled: | X | | |
| 6. COC agrees w/ bottles received: (Comment on COC if N) | ✓ | | |
| 7. COC agrees w/ labels: (Comment on COC if N) | ✓ | | |
| 8. Headspace in vials-waters only: (Comment on COC if Y) | | | ✓ |
| 9. VOA samples preserved: | | | ✓ |
| 10. pH measured on metals, cyanide or phenolics*: | | | ✓ |

List discrepancies ____

*Non-EAL provided containers only, water samples only.

| | Y | N |
|---|---|---|
| 11. Metal samples present: | | ✓ |
| Total ____ , Dissolved ____ , TCLP ____ | | |
| D or PD to be filtered: | | |
| T,TR,D,PD to be Preserved: | | |
| 12. Short holding times: | ✓ | |
| Specify parameters $NO_2$, $NO_3$ | | |
| 13. Multi-phase sample(s) present: | | ✓ |
| 14. COC signed w/ date/time: | ✓ | |

Comments: ____

(Additional comments on back)

Custodian Signature/Date: [signature] 3-16-96

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Analysis Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/15/96 | Client Project ID. | : 722450.14020 |
| Date Received | : 3/16/96 | Lab Project Number | : 96-0805 |
| Date Prepared | : 3/27/96 | Method | : EPA 310.1 |
| Date Analyzed | : 3/27/96 | Detection Limit | : 5.0 mg $CaCO_3$/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Total Alkalinity (mg $CaCO_3$/L) | Dilution Factor |
|---|---|---|---|---|
| X20559 | BE-SW01-01 | Water | 42.2 | 1 |
| X20560 | BE-SW02-01 | Water | 92.2 | 1 |
| X20561 | BE-SW03-01 | Water | 40.3 | 1 |
| X20562 | BE-SW12-01 | Water | 93.2 | 1 |
| Method Blank | (3/27/96) | | <5.0 | |

### Quality Assurance

| Reference | True Value (mg$CaCO_3$/L) | Result (mg$CaCO_3$/L) | % Recovery |
|---|---|---|---|
| ERA Alkalinity Lot # 0814-95-02 | 120 | 122 | 102 |

Analyst

Approved

# Evergreen Analytical Sample Log Sheet

**Project # 96-0805**

**Date(s) Sampled:** 03/15/96 COC

**Date Due:** 04/01/96

**e Received:** 03/16/96 0927

**Holding Time(s):** 3/17-$NO_2$,$NO_3$,3/22-ALK

**nt Project I.D.** BEALE AFB,UST SITES

**Rush** STANDARD

**Client:** PARSONS ENGINEERING SCIENCE, INC.
**Address:** 1301 MARINA VILLAGE PKWY #200
ALAMEDA, CA 94501
**Contact:** MICHAEL PHELPS
**Phone #**510-769-0100 **Fax #** **

**Cooler Return** 5.00
**E.A. Cooler #** N/A
**Airbill #** FEDEX 0701091495
**Client P.O.** 722450.14020

**Special Invoicing/Billing**

Special Instructions **DO NOT FAX RESULTS.**

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X20559A | BE-SW01-01 | ALKALINITY | W | 125P | C6 |
| X20560A | BE-SW02-01 | ALKALINITY | W | 125P | C6 |
| 561A | BE-SW03-01 | ALKALINITY | W | 125P | C6 |
| X2[illegible]562A | BE-SW12-01 | ALKALINITY | W | 125P | C6 |
| X[illegible]9B | BE-SW01-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C6 |
| X20560B | BE-SW02-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C6 |
| X20561B | BE-SW03-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C6 |

R=Sample to be returned

ate GC/MS ___ GC ___ Metals ___ Wet Chem X HPLC ___ SxPrep ___

T SxRec C QA/QC C Acctg C File Orig

**Page 1 of 1 Page(s)**

**Custodian/Date:** [illegible] 3/1[illegible]/96
MM 3/18/96

# CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

**Evergreen Analytical Inc.**
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 1

COMPANY PARSONS ES
ADDRESS 1301 MARINA VILLAGE PKWY, #200
CITY ALAMEDA STATE CA ZIP 94501
PHONE# 510-769-0100 FAX # 510-769-9244
FAX RESULTS Y / N
FAC COC Yes

CLIENT CONTACT (print) Michael Phelps
PROJECT I.D. Beale AFB, UST Sites
EAL. QUOTE # ______ P.O.# 722450.14020
TURNAROUND REQUIRED* normal
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Michael Phelps
(print) Michael Phelps

Evergreen Analytical Cooler No. —
Cooler Received ______

Please **PRINT** all information:

EAL use only
Do not write in shaded area

EAL
Project # 96-0805
Custodian 9IA

| CLIENT SAMPLE IDENTIFICATION | DATE SAMPLED | TIME | No. of Containers | MATRIX: Water-Drinking/Discharge/Ground (circle) SURFACE | MATRIX: Soil / Solid | MATRIX: Oil / Sludge | TCLP VOA/BNA/Pest/Herb/Metals (circle) | VOA 8260/624/524.2 (circle) | BNA 8270/625 (circle) | Pesticides 8080/608 (circle) | Pest/PCBs 8080/608/508 (circle) | Herbicides 8150/515 (circle) | PCB Screen | BTEX 8020/602 (circle)/MTBE (circle) | TRPH 418.1/Oil & Grease 413.1 (circle) | TVPH 8015mod. (Gasoline) | TEPH 8015mod. (Diesel) | Total Metals-DW / NPDES / SW846 (circle & list metals below) | Dissolved Metals - DW / SW846 (circle & list metals below) | Alkalinity | Anions (Nitrate, Nitrite, Sulfate, Chloride) | EAL Sample No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-SW01-01 | 3/15/96 | 1120 | 2 | X | | | | | | | | | | | | | | | | X | X | X20559 A/B |
| BE-SW02-01 | 3/15/96 | 1220 | 2 | X | | | | | | | | | | | | | | | | X | X | 560 |
| BE-SW03-01 | 3/15/96 | 1415 | 2 | X | | | | | | | | | | | | | | | | X | X | 561 |
| BE-SW12-01 | 3/15/96 | 1230 | ~~2~~ 1 | X | | | | | | | | | | | | | | | | X | ~~X~~ | 562 A |

HT:
DD:
Location C6
Container Size 125P

Instructions: BE-SW12-01 is Alkalinity only.

| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time | Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time |
|---|---|---|---|---|---|---|---|
| [signature] | 3/15/96 1500 | [signature] | 3/16 0927 | | | | |

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

# Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/13/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/14/96 | Lab Project Number | : | 96-0776 |
| Date Prepared | : | 3/15/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/15/96 | Detection Limit | : | 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Sulfate mg/L | Dilution Factor |
|---|---|---|---|---|
| X20416 | BE-MP10-01 | Water | 12.2 | 1 |
| X20417 | BE-MP12-01 | Water | 21.1 | 1 |
| X20418 | BE-MP13-01 | Water | 1.1 | 1 |
| Method Blank | (3/15/96) | | <0.25 | |

## Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20416 | BE-MP10-01 Matrix Spike | 10.0 | 12.2 | 21.2 | 91 |
| X20416 | BE-MP10-01 Matrix Spike Dup | 10.0 | 12.2 | 22.0 | 98 |
| MS/MSD RPD | | | | | 7.7 |

Analyst

Approved

# EVERGREEN ANALYTICAL, Inc.

4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/13/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/14/96 | Lab Project Number | : | 96-0776 |
| Date Prepared | : | 3/15/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/15/96 | Detection Limit | : | 0.076 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrite-N mg/L | Dilution Factor |
|---|---|---|---|---|
| X20416 | BE-MP10-01 | Water | <7.6 [1] | 100 |
| X20417 | BE-MP12-01 | Water | <0.076 | 1 |
| X20418 | BE-MP13-01 | Water | <0.76 [1] | 10 |
| Method Blank | (3/15/96) | | <0.076 | |

### Quality Assurance *

| | | Spike Amount (mg/L) | Sample Result [2] (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20416 | BE-MP10-01 Matrix Spike | 10.0 | <25 | 9.6 | 96 |
| X20416 | BE-MP10-01 Matrix Spike Dup | 10.0 | <25 | 9.6 | 96 |
| MS/MSD RPD | | | | | 0.62 |

* = Quality assurance results reported as Nitrite ($NO_2$).
(1) = Raised detection limit due to matrix interference.
(2) = Sample result based on a 100X dilution factor due to matrix interference.

Analyst

Approved

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/13/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/14/96 | Lab Project Number | : | 96-0776 |
| Date Prepared | : | 3/15/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/15/96 | Detection Limit | : | 0.056 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrate-N mg/L | Dilution Factor |
|---|---|---|---|---|
| X20416 | BE-MP10-01 | Water | 0.083 | 1 |
| X20417 | BE-MP12-01 | Water | 0.46 | 1 |
| X20418 | BE-MP13-01 | Water | 0.067 | 1 |
| Method Blank | (3/05/96) | | <0.056 | |

### Quality Assurance *

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20416 | BE-MP10-01 Matrix Spike | 10.0 | 0.37 | 9.1 | 87 |
| X20416 | BE-MP10-01 Matrix Spike Dup | 10.0 | 0.37 | 9.6 | 92 |
| MS/MSD RPD | | | | | 5.9 |

* = Quality assurance results reported as Nitrate ($NO_3$).

Analyst

Approved

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Analysis Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/13/96 | Client Project ID. | : 722450.14020 |
| Date Received | : 3/14/96 | Lab Project Number | : 96-0776 |
| Date Prepared | : 3/20/96 | Method | : Standard Method 4500-$NH_3$F |
| Date Analyzed | : 3/20/96 | Detection Limit | : 0.80 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Ammonia-N | Dilution Factor |
|---|---|---|---|---|
| X20416 | BE-MP10-01 | Water | 1.8 mg/L | 1 |
| X20417 | BE-MP12-01 | Water | <0.80 mg/L | 1 |
| X20418 | BE-MP13-01 | Water | <0.80 mg/L | 1 |
| Method Blank | (3/20/96) | | <0.80 mg/L | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| 96-0741 X20229 | Matrix Spike | 10.0 | <0.80 | 9.9 | 99 |
| X20229 | Matrix Spike Dup | 10.0 | <0.80 | 9.9 | 99 |
| MS/MSD RPD | | | | | 0.0 |

Analyst

Approved

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/13/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/14/96 | Lab Project Number | : | 96-0776 |
| Date Prepared | : | 3/15/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/15/96 | Detection Limit | : | 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Chloride mg/L | Dilution Factor |
|---|---|---|---|---|
| X20416 | BE-MP10-01 | Water | 348 | 100 |
| X20417 | BE-MP12-01 | Water | 136 | 10 |
| X20418 | BE-MP13-01 | Water | 195 | 10 |
| Method Blank | (3/15/96) | | <0.25 | |

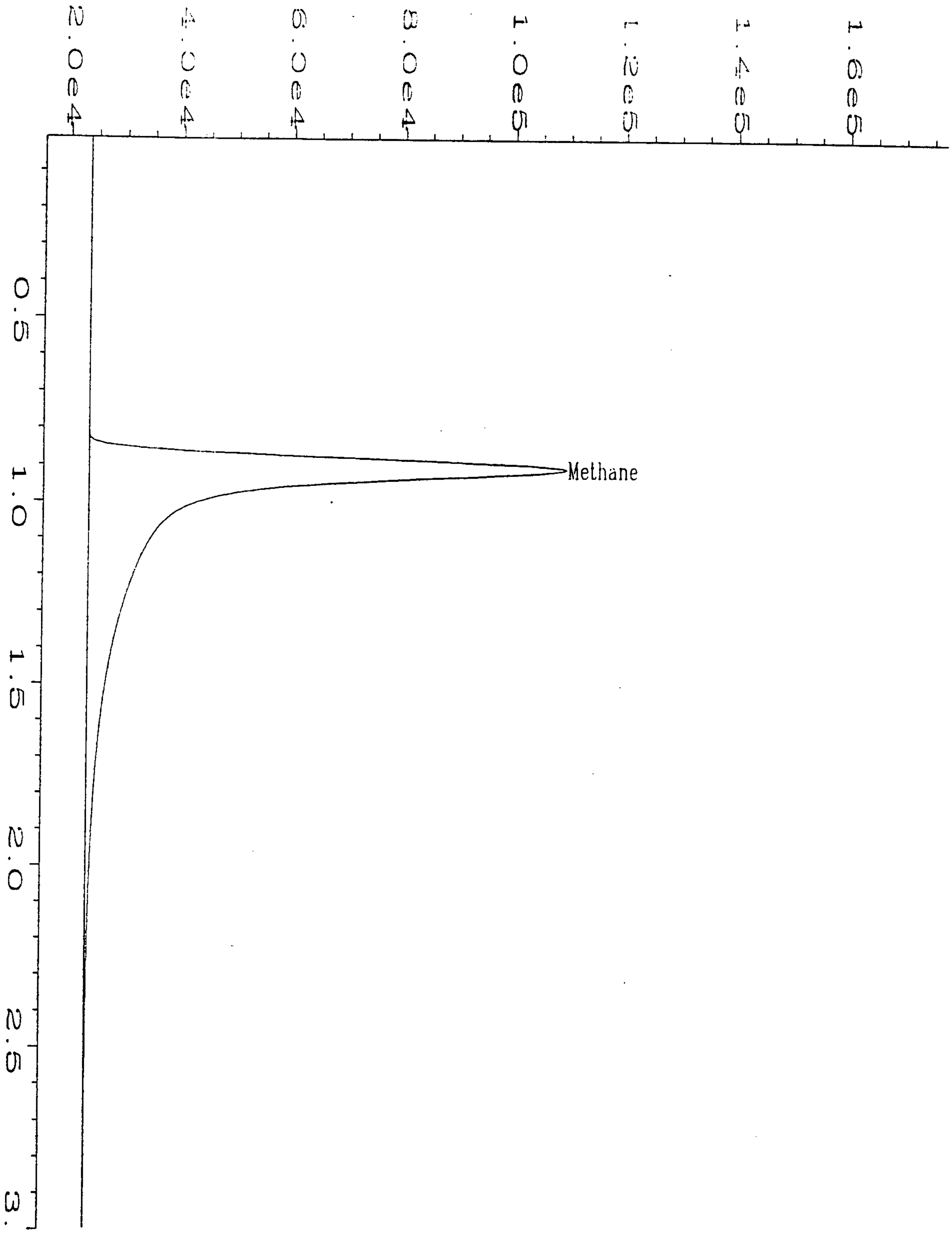
### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result * (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20416 | BE-MP10-01 Matrix Spike | 10.0 | 3.5 | 12.8 | 94 |
| X20416 | BE-MP10-01 Matrix Spike Dup | 10.0 | 3.5 | 12.6 | 92 |
| MS/MSD RPD | | | | | 2.3 |

* = Sample result based on a 100X dilution factor.

Analyst

Approved




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0325\008R0101.D | | | | |
| Operator | : Bill Michener | Page Number | : 1 | | |
| Instrument | : ALCGAS | Vial Number | : 8 | | |
| Sample Name | : LCS032596;Gas | Injection Number | : 1 | | |
| Time Bar Code | : | Sequence Line | : 1 | | |
| Acquired on | : 25 Mar 96 09:57 AM | Instrument Method | : GAS.MTH | | |
| Report Created on | : 25 Mar 96 10:06 AM | Analysis Method | : GAS0325.MTH | | |
| Last Recalib on | : 25 MAR 96 09:44 AM | Sample Amount | : 0 | | |
| Multiplier | : 1 | ISTD Amount | : | | |
| Sample Info | : Laboratory Control Sample | | | | |
| | Displaced 4ml of deionized water in 43ml vial with 1% | | | | |

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## Analysis Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/13/96 | Client Project ID. | : 722450.14020 |
| Date Received | : 3/14/96 | Lab Project Number | : 96-0776 |
| Date Prepared | : 3/18/96 | Method | : EPA 310.1 |
| Date Analyzed | : 3/18/96 | Detection Limit | : 5.0 mg $CaCO_3$/L |

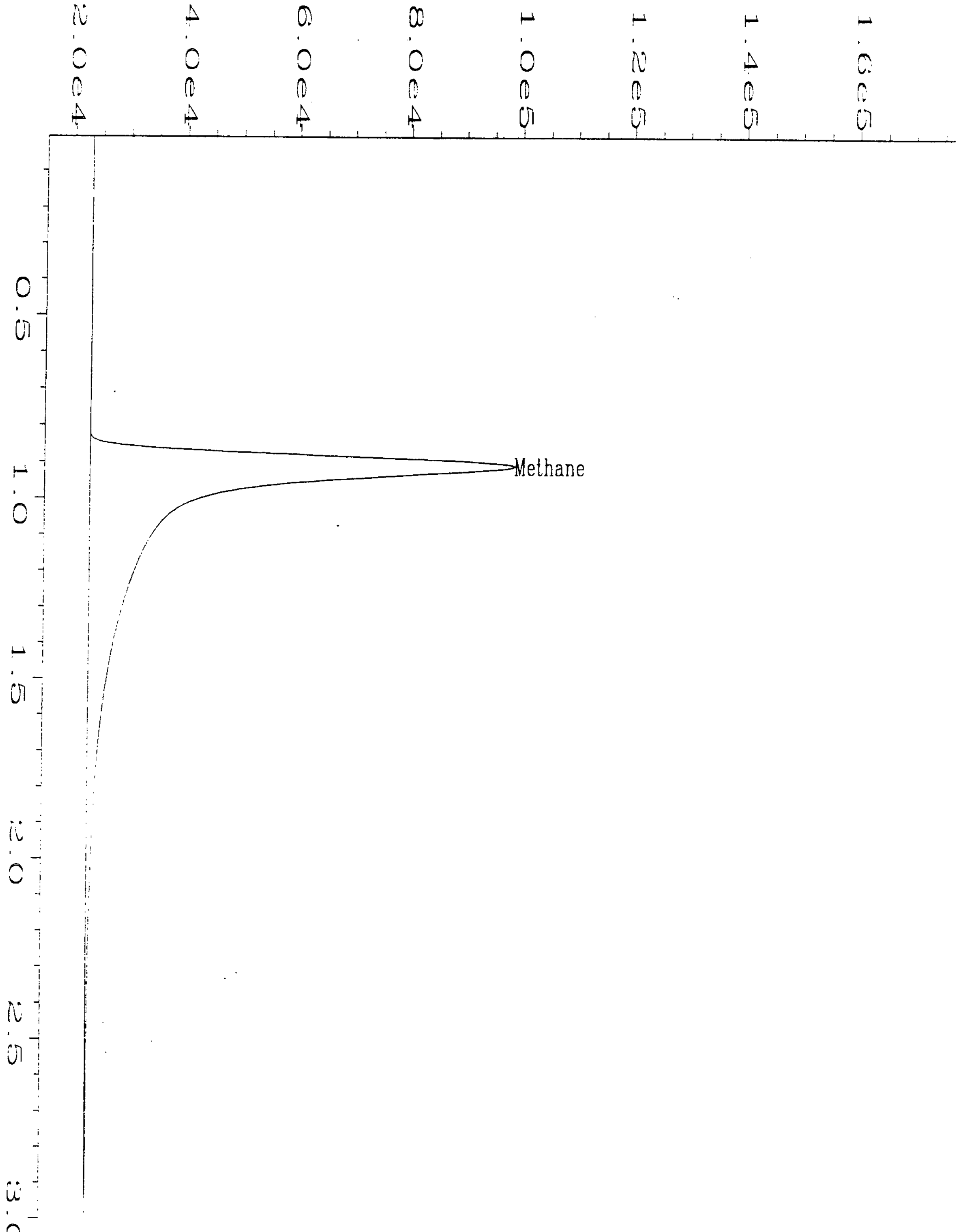
| Evergreen Sample # | Client Sample ID. | Matrix | Total Alkalinity (mg $CaCO_3$/L) | Dilution Factor |
|---|---|---|---|---|
| X20416 | BE-MP10-01 | Water | 690 | 1 |
| X20417 | BE-MP12-01 | Water | 213 | 1 |
| X20418 | BE-MP13-01 | Water | 575 | 1 |
| | | | | |
| Method Blank | (3/18/96) | | <5.0 | |

### Quality Assurance

| Reference | True Value (mg$CaCO_3$/L) | Result (mg$CaCO_3$/L) | % Recovery |
|---|---|---|---|
| ERA Alkalinity Lot # 0814-95-06 | 120 | 116 | 97 |

Analyst

Approved




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0325\020R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X20417MSD;1
Run Time Bar Code:
uired on : 25 Mar 96 01:37 PM
ort Created on: 25 Mar 96 01:42 PM
La Recalib on : 25 MAR 96 09:44 AM
Mu plier : 1
Sample Info : 96-0776;BE-MP12-01;Displaced 4ml with 1% methane gas(#1723), shook for 5 min. and injected 50ul to equal a theoretical spike of 500ug. The sample is injected at a

Page Number : 1
Vial Number : 20
Injection Number : 1
Sequence Line : 1
Instrument Method: GAS.MTH
Analysis Method : GAS0325.MTH
Sample Amount : 0
ISTD Amount :

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(303) 425-6021

# RSK-175 Gas Method
## Methane LCS Report Form

| | | | |
|---|---|---|---|
| LCS No. | : LCS032596 | EPA Method No. | : RSKSOP-175 |
| Date Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Method Blank | : GB032596 |
| E.A. LCS Source No. | : 1723 | Lab File No. | : GAS0325008 |

| Compound | Spike Added (ug) | Method Blank Concentration (ug) | LCS Concentration (ug) | LCS %REC | QC Limits %REC |
|---|---|---|---|---|---|
| Methane Gas | 500 | 0 | 407 | 81 | 67-85 |

Spike Recovery: 0 out of (1) outside limits.

Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

Approved

LCS0325.XLS; 3/25/96

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RSK-175 Gas Method
Methane, Ethane, Ethene Gas Matrix Spike / Matrix Spike Duplicate Report

| | | | |
|---|---|---|---|
| Client Sample No. | : BE-MP12-01 | Client Project No. | : 722450.14020 |
| Lab Sample No. | : X20417 | Lab Project No. | : 96-0776 |
| Date Sampled | : 3/13/96 | EPA Method No. | : RSKSOP-175 |
| Date Received | : 3/14/96 | Matrix | : Water |
| Date Prepared | : 3/25/96 | Method Blank | : GB032596 |
| Date Analyzed | : 3/25/96 | Lab File No's. | : GAS0325019,020 |
| E.A. MS/MSD Spike Source No. | : 1723 | | |

| Compound | Spike Added (ug) | Sample Concentration (ug) | MS Concentration (ug) | MS %REC | QC Limits %REC |
|---|---|---|---|---|---|
| Methane Gas | 500 | 0 | 379 | 76 | 40-89 |

| Compound | Spike Added (ug) | MSD Concentration (ug) | MSD %REC | RPD | QC Limits | |
|---|---|---|---|---|---|---|
| | | | | | RPD | %REC |
| Methane Gas | 500 | 382 | 76 | 0.8 | 0-24.4 | 40-89 |

RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

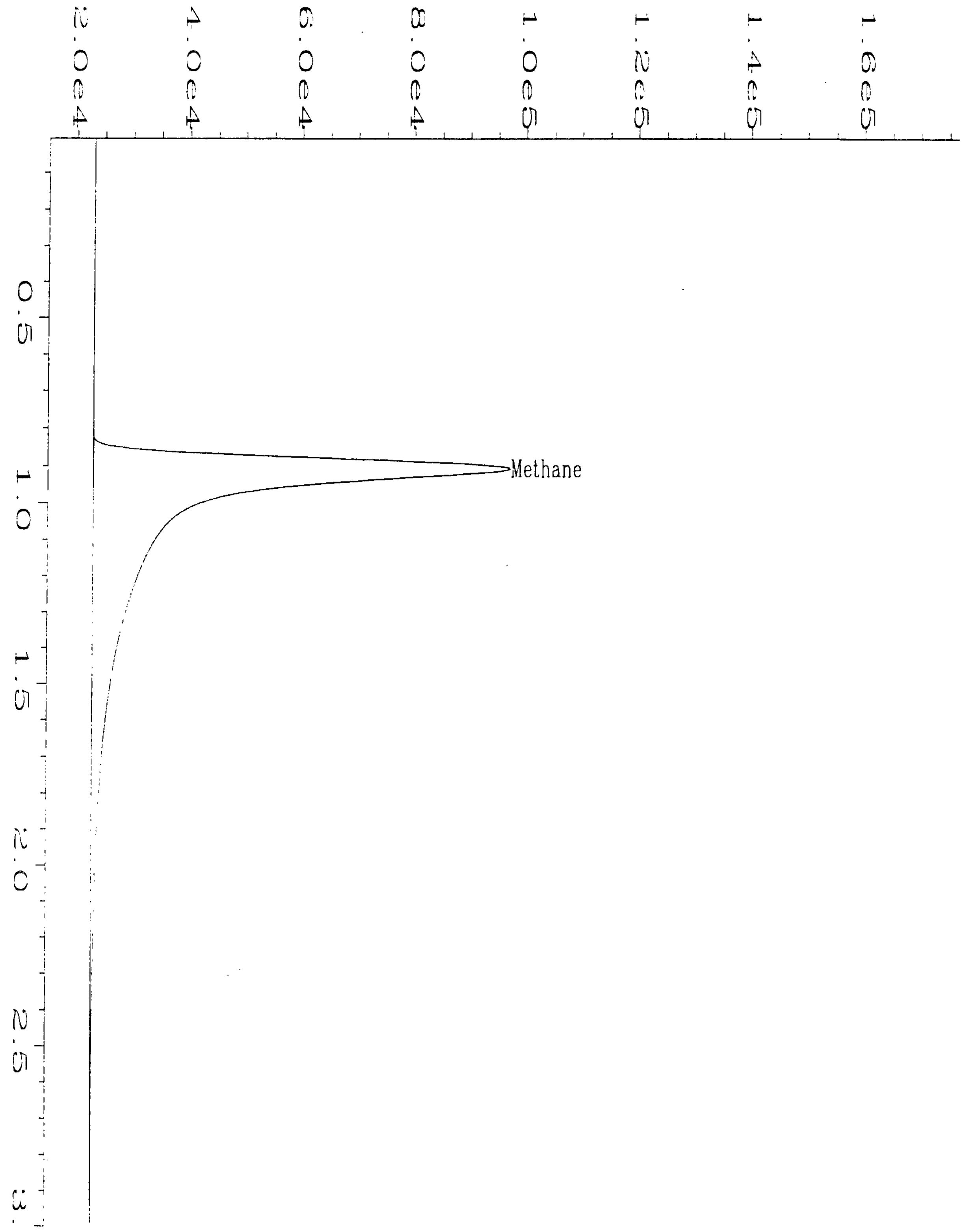
NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available

Note: The Spike was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

Analyst

Approved

MS0776.XLS; 3/25/96




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : | C:\HPCHEM\ALCGAS\DATA\GAS0325\019R0101.D | | | |
| Operator | : | Bill Michener | Page Number | : | 1 |
| Instrument | : | ALCGAS | Vial Number | : | 19 |
| Sample Name | : | X20417MS;1 | Injection Number | : | 1 |
| Run Time Bar Code | : | | Sequence Line | : | 1 |
| Acquired on | : | 25 Mar 96 01:33 PM | Instrument Method | : | GAS.MTH |
| Report Created on | : | 25 Mar 96 01:42 PM | Analysis Method | : | GAS0325.M |
| Last Recalib on | : | 25 MAR 96 09:44 AM | Sample Amount | : | 0 |
| Multiplier | : | 1 | ISTD Amount | : | |

Sample Info : 96-0776;BE-MP12-01;Displaced 4ml with 1% methane gas(#1723), shook for 5 min. and injected 50ul to equal a theoretical spike of 500ug. The sample is injected at a

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# Methane Report Form

| | | | |
|---|---|---|---|
| [redacted]t Sample Number | : BE-MP13-01 | Client Project No. | : 722450.14020 |
| [redacted] Sample Number | : X20418 | Lab Project No. | : 96-0776 |
| Date Sampled | : 3/13/96 | Dilution Factor | : 50.00 |
| Date Received | : 3/14/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Lab File No. | : GAS0325017 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 1.6 | 0.1 |

| | | | | |
|---|---|---|---|---|
| nperature | : 75 F | Saturation Concentration | Meth | 0.38539415 |
| . .nount Injected | : 0.01 ml | | | |
| T[redacted]Volume of Sample | : 43 ml | Concentration in Head Space | Meth | 1.207475299 |
| [redacted]space created | : 4 ml | | | |
| Methane Area | : 179.243 ug | | | |
| Atomic weight(Methane) | : 16 g | | | |

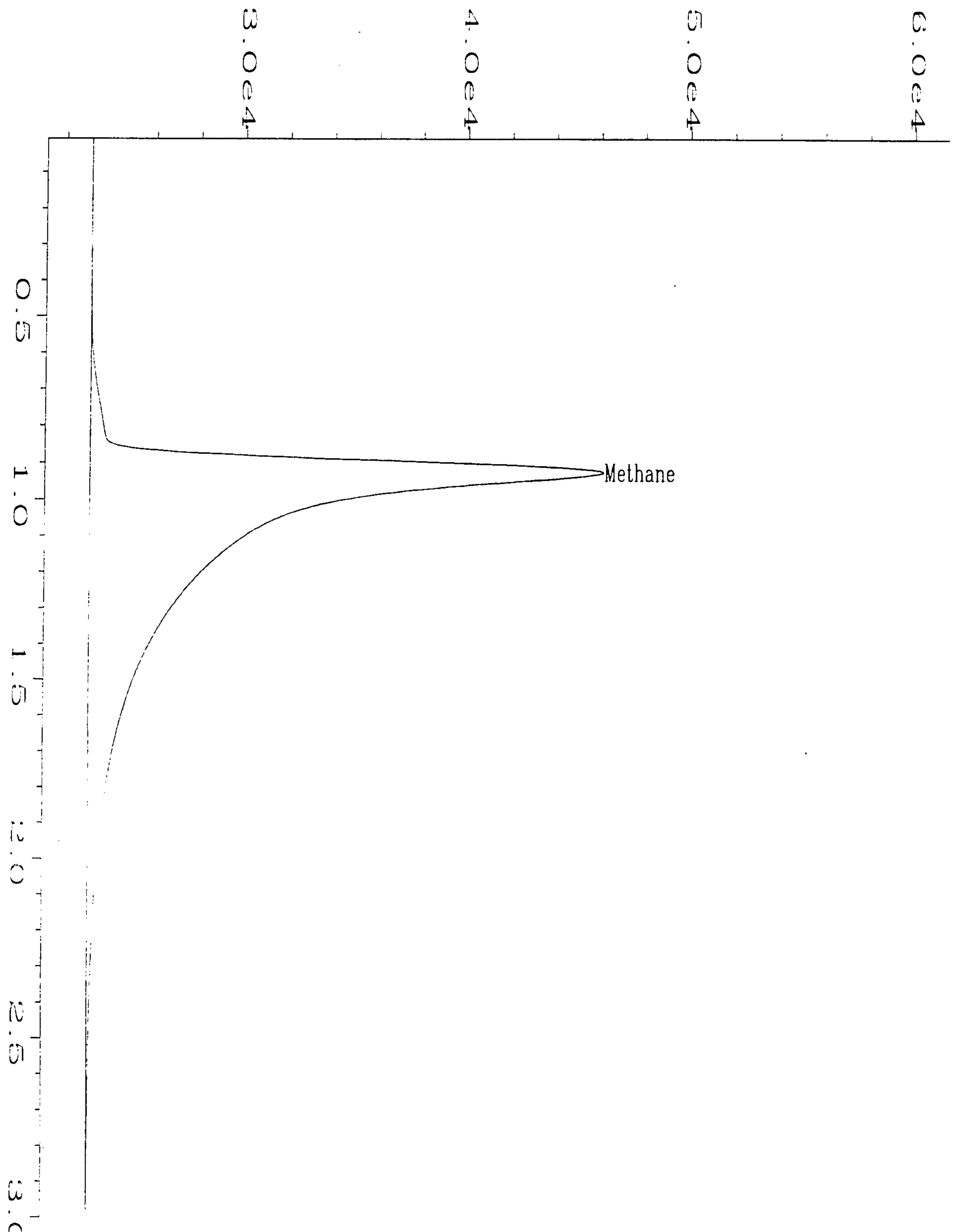
QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

Analyst

Approved

AF0776.XLS




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : | C:\HPCHEM\ALCGAS\DATA\GAS0325\017R0101.D | | | |
| Operator | : | Bill Michener | Page Number | : | 1 |
| Instrument | : | ALCGAS | Vial Number | : | 17 |
| Sample Name | : | X20418;50 | Injection Number | : | 1 |
| Run Time Bar Code | : | | Sequence Line | : | 1 |
| Acquired on | : | 25 Mar 96 01:09 PM | Instrument Method | : | GAS.MTH |
| Report Created on | : | 25 Mar 96 01:42 PM | Analysis Method | : | GAS0325.M |
| Last Recalib on | : | 25 MAR 96 09:44 AM | Sample Amount | : | 0 |
| Multiplier | : | 1 | ISTD Amount | : | |
| Sample Info | : | 96-0776;BE-MP13-01;Water | | | |

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Methane Report Form

| | | | |
|---|---|---|---|
| [redacted]t Sample Number | : BE-MP12-01 | Client Project No. | : 722450.14020 |
| [redacted] Sample Number | : X20417 | Lab Project No. | : 96-0776 |
| Date Sampled | : 3/13/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/14/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Lab File No. | : GAS0325016 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | | |
|---|---|---|---|---|
| nperature | : 73.8 F | Saturation Concentration | Meth | 0.000108839 |
| ,..mount Injected | : 0.5 ml | | | |
| [redacted]Volume of Sample | : 43 ml | Concentration in Head Space | Meth | 0.00034177 |
| [redacted]space created | : 4 ml | | | |
| Methane Area | : 2.531 ug | | | |

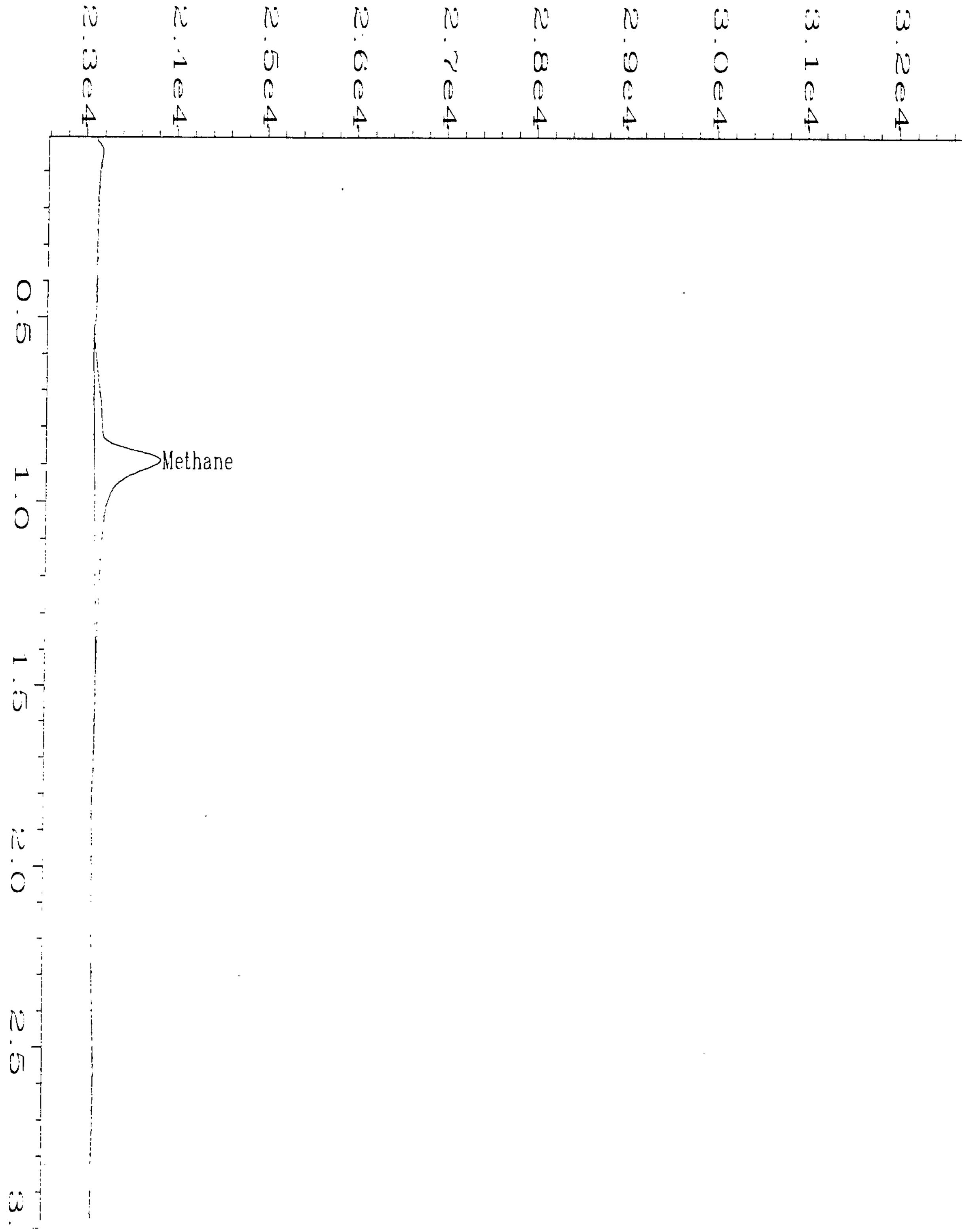
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

Approved

AF0776.XLS




| | | | |
|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0325\016R0101.D | | |
| Operator | : Bill Michener | Page Number | : 1 |
| Instrument | : ALCGAS | Vial Number | : 16 |
| Sample Name | : X20417;1 | Injection Number | : 1 |
| Run Time Bar Code | : | Sequence Line | : 1 |
| Acquired on | : 25 Mar 96 12:59 PM | Instrument Method | : GAS.MTH |
| Report Created on | : 25 Mar 96 01:42 PM | Analysis Method | : GAS0325.M |
| Last Recalib on | : 25 MAR 96 09:44 AM | Sample Amount | : 0 |
| Multiplier | : 1 | ISTD Amount | : |
| Sample Info | : 96-0776;BE-MP12-01;Water | | |

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## Methane Report Form

| | | | |
|---|---|---|---|
| t Sample Number | : BE-MP10-01 | Client Project No. | : 722450.14020 |
| Sample Number | : X20416 | Lab Project No. | : 96-0776 |
| Date Sampled | : 3/13/96 | Dilution Factor | : 20.00 |
| Date Received | : 3/14/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Lab File No. | : GAS0325015 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 0.85 | 0.04 |

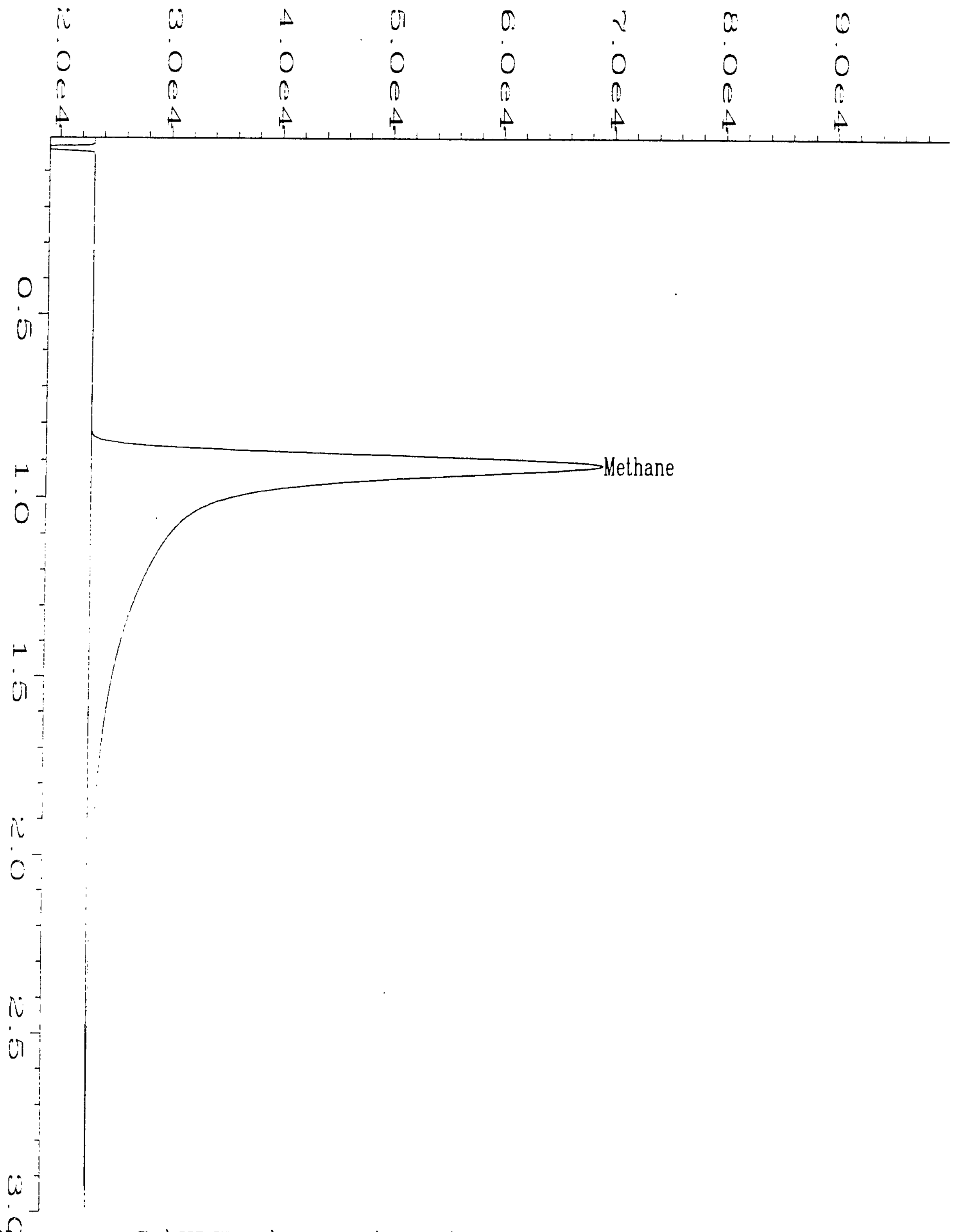
| | | | | |
|---|---|---|---|---|
| mperature | : 72.6 F | Saturation Concentration | Meth | 0.204572839 |
| nount Injected | : 0.025 ml | Concentration in Head Space | Meth | 0.643836992 |
| Volume of Sample | : 43 ml | | | |
| space created | : 4 ml | | | |
| ane Area | : 237.862 ug | | | |
| Atomic weight(Methane) | : 16 g | | | |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0776.XLS




| | | | | |
|---|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0325\015R0101.D | | | |
| Operator | : Bill Michener | Page Number | : | 1 |
| Instrument | : ALCGAS | Vial Number | : | 15 |
| Sample Name | : X20416;20 | Injection Number | : | 1 |
| Run Time Bar Code: | | Sequence Line | : | 1 |
| Acquired on | : 25 Mar 96 12:46 PM | Instrument Method | : | GAS.MTH |
| Report Created on | : 25 Mar 96 01:42 PM | Analysis Method | : | GAS0325.M |
| Last Recalib on | : 25 MAR 96 09:44 AM | Sample Amount | : | 0 |
| Multiplier | : 1 | ISTD Amount | : | |
| Sample Info | : 96-0776;BE-MP10-01;Water | | | |

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# Methane Report Form
## Method Blank Report

| | | | |
|---|---|---|---|
| Method Blank Number | : GB032596 | Client Project No. | : 722450.14020 |
| Date Extracted/Prepared | : 3/25/96 | Lab Project No. | : 96-0776 |
| Date Analyzed | : 3/25/96 | Dilution Factor | : 1.00 |
| | | Method | : RSKSOP-175 |
| | | Matrix | : Water |
| | | Lab File No. | : GAS0325002 |

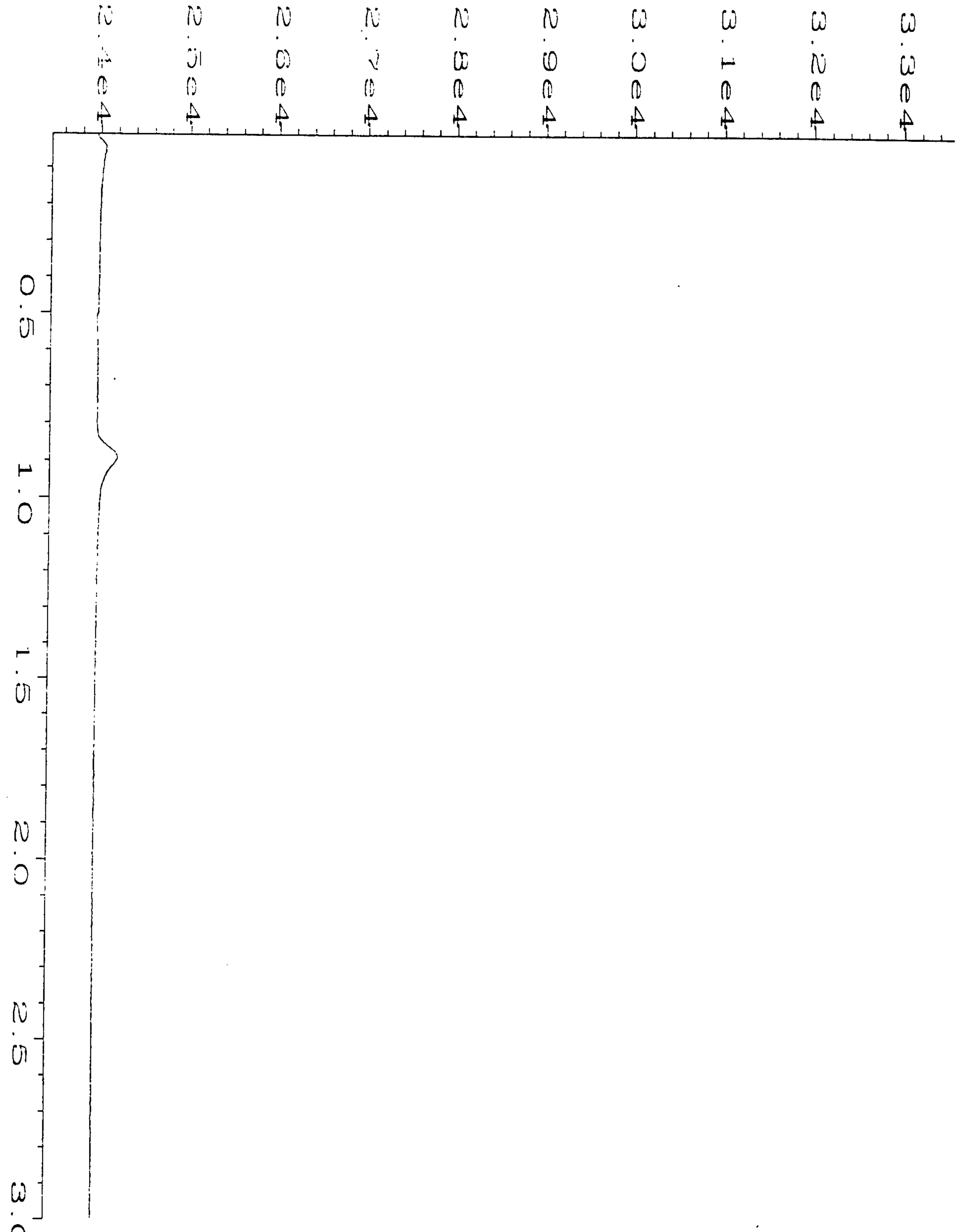
| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0776.XLS




| | | | | |
|---|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0325\002R0101.D | | | |
| Operator | : Bill Michener | Page Number | : | 1 |
| Instrument | : ALCGAS | Vial Number | : | 2 |
| Sample Name | : GB032596 | Injection Number | : | 1 |
| Run Time Bar Code: | | Sequence Line | : | 1 |
| Acquired on | : 25 Mar 96 08:51 AM | Instrument Method: | | GAS.MTH |
| Report Created on: | 25 Mar 96 09:45 AM | Analysis Method | : | GAS0325.M |
| Last Recalib on | : 25 MAR 96 09:44 AM | Sample Amount | : | 0 |
| Multiplier | : 1 | ISTD Amount | : | |
| Sample Info | : Gas Method Blank | | | |

Displaced 4ml of deionized water in 43ml vial with Helium, shook for 5 min. and injected 500ul

Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3/14/96 0925 Shipped Via: Fed X 1154092520
(Airbill # if applicable)

Client : Parsons ES

Client Project ID(s): 722450.14020

EAL Project #(s): 96- 0776 EAL Cooler(s): Y N

| | | | | | |
|---|---|---|---|---|---|
| Cooler# | 735 | | | | |
| Ice packs | Y N | Y N | Y N | Y N | Y N |
| Temperature °C | 5 | | | | |

| | Y | N | N/A |
|---|---|---|---|
| 1. Custody seal(s) present: | X | | |
| Seals on cooler intact | X | | |
| Seals on bottle intact | | | X |
| 2. Chain of Custody present: | X | | |
| 3. Samples Radioactive: (Comment on COC if > 0.5mr/h) | | X | |
| 4. Containers broken or leaking: (Comment on COC if Y) | | X | |
| 5. Containers labeled: | X | | |
| 6. COC agrees w/ bottles received: (Comment on COC if N) | | X | |
| Rec'd only 6 bottles for BE-MP12-01- No alkalinity bottle rec'd - mpm | | | |
| 7. COC agrees w/ labels: (Comment on COC if N) | X | | |
| 8. Headspace in vials-waters only: (Comment on COC if Y) | | X | |
| 9. VOA samples preserved: | X | | |
| 10. pH measured on metals, cyanide or phenolics*: | | | X |

List discrepancies

*Non-EAL provided containers only, water samples only.

| | Y | N |
|---|---|---|
| 11. Metal samples present: | | X |
| Total ____, Dissolved ____, TCLP ____ | | |
| D or PD to be filtered: | | |
| T,TR,D,PD to be Preserved: | | |
| 12. Short holding times: | X | |
| Specify parameters NO2/NO3 | | |
| 13. Multi-phase sample(s) present: | | X |
| 14. COC signed w/ date/time: | X | |

Comments:

(Additional comments on back)

Custodian Signature/Date: mpm 3/14/96

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(303) 425-6021

## Total Organic Carbon

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : 3/13/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : 3/14/96 | Lab Project Number | : | 96-0776 |
| Date Prepared | : 3/15/96 | Method | : | EPA 415.1 |
| Date Analyzed | : 3/15/96 | Detection Limit | : | 1.0 mg C/L |

| Evergreen Sample # | Client Sample ID. | Matrix | TOC mg C/L | Dilution Factor |
|---|---|---|---|---|
| X20416 | BE-MP10-01 | Water | 65.7 | 1 |
| X20417 | BE-MP12-01 | Water | 5.2 | 1 |
| X20418 | BE-MP13-01 | Water | 36.8 | 1 |
| Method Blank | (3/15/96) | | <1.0 | |

## Quality Assurance

| | | Spike Amount (mgC/L) | Sample Result (mgC/L) | Spike Result (mgC/L) | % Recovery |
|---|---|---|---|---|---|
| X20416 | BE-MP10-01 Matrix Spike | 10.0 | 65.7 | 76.8 | 112 |
| X20416 | BE-MP10-01 Matrix Spike Dup | 10.0 | 65.7 | 77.6 | 119 |
| MS/MSD RPD | | | | | 6.4 |

Analyst

Approved

# Evergreen Analytical Sample Log Sheet

**Project # 96-0776**

**Date(s) Sampled:** 03/13/96 COC

**Date Due:** 03/28/96

**te Received:** 03/14/96 0925

**Holding Time(s):** 03/15-$NO_2$,$NO_3$, 03/27-ALKALINITY

**Cl nt Project I.D.** 722450.14020

**Rush** STANDARD

**Client:** PARSONS ENGINEERING SCIENCE, INC.
**Address:** 1301 MARINA VILLAGE PKWY #200
ALAMEDA, CA 94501
**Contact:** MICHAEL PHELPS
**Phone #**510-769-0100 **Fax #**510-769-9244

**Cooler Return** N/A
**E.A. Cooler #** 735
**Airbill #** FEDEX 1154092520
**Client P.O.**

**Special Invoicing/Billing**

**Special Instructions**

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X20416A | BE-MP10-01 | TOC | W | 125A | CR3 |
| X20417A | BE-MP12-01 | TOC | W | 125A | CR3 |
| X?0418A | BE-MP13-01 | TOC | W | 125A | CR3 |
| …416B | BE-MP10-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | CR3 |
| X2…7B | BE-MP12-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$,ALKALINITY | W | 125P | CR3 |
| X2…18B | BE-MP13-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | CR3 |
| X20416C | BE-MP10-01 | AMMONIA | W | 500P | CR3 |
| X20417C | BE-MP12-01 | AMMONIA | W | 500P | CR3 |
| X20418C | BE-MP13-01 | AMMONIA | W | 500P | CR3 |
| X20416D | BE-MP10-01 | ALKALINITY | W | 500P | CR3 |
| X20418D | BE-MP13-01 | ALKALINITY | W | 500P | CR3 |
| X20416E-G | BE-MP10-01 | METHANE | W | 40V | CR3 |
| X20417E/F | BE-MP12-01 | METHANE | W | 40V | CR3 |
| X20418E/F | BE-MP13-01 | METHANE | W | 40V | CR3 |

R=Sample to be returned

te GC/MS __ GC X Metals __ Wet Chem X HPLC __ SxPrep __

SxRec C QA/QC C Acctg C File Orig

Page 1 of 1 Page(s)

**Custodian/Date:** 3/21/96
Am 3/22/96

# CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Page 1 of 1

**Evergreen Analytical Inc.**
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY PARSONS ES
ADDRESS 1301 MARINA VILLAGE PKWY ST 2~~00~~
CITY ALAMEDA STATE CA ZIP 94501
PHONE# 510 769 0100 FAX # 510 769 9244 FAX RESULTS Y / N
Sampler Name: HILARY EICHLER
(signature) MIKE FRIEDMAN
(print) [signature]
Evergreen Analytical Cooler No. ____
Cooler Received ____

CLIENT CONTACT (print) MICHAEL PHELPS
PROJECT I.D. 722450.14020
EAL. QUOTE # ____ P.O.# ____
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day)
☐ Other (Specify) ____
*expedited turnaround subject to additional fee

EAL use only
Do not write
in shaded area

EAL
Project # 96-0776
Custodian mjm

Please **PRINT** all information:

| CLIENT SAMPLE IDENTIFICATION | DATE SAMPLED | TIME | No. of Containers | MATRIX: Water-Drinking/Discharge/Ground (circle) | Soil / Solid | Oil / Sludge | TCLP VOA/BNA/Pest/Herb/Metals (circle) | VOA 8260/624/524.2 (circle) | ~~BNA 8270/625 (circle)~~ TOC | Pesticides 8080/608 (circle) | Pest/PCBs 8080/608/508 (circle) | Herbicides 8150/515 (circle) | PCB Screen | BTEX 8020/602 (circle)/MTBE (circle) | TRPH 418.1/Oil & Grease 413.1 (circle) | TVPH 8015mod. (Gasoline) | TEPH 8015mod. (Diesel) | Total Metals-DW / NPDES / SW846 (circle & list metals below) | Dissolved Metals - DW / SW846 (circle & list metals below) | ANIONS (NITRATE, SULFATE, NITRITE, CHLORIDE) | DISSOLVED AMMONIA | ALKALINITY | METHANE | EAL Sample No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP10-01 | 3/13/96 | 0935 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | X20416 A-G |
| BE-MP12-01 | | 1015 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | 17 A-F |
| BE-MP13-01 | | 1155 | 6 | X | | | | | X | | | | | | | | | | | X | X | X | X | 18 A-F |
| ~~BE-MP47-01~~ | | ~~1103~~ | | | | | | | | | | | | | | | | | | | | | | |
| HT: | | | | | | | | | | | | | | | | | | | | | | | | Location 2, CR3 |
| DD: | | | | | | | | | 125 A | | | | | | | | | | | 125 P | 500 P | 125 P | 40 V | Container Size ← |

1/2 Full mm

missing mm

Instructions:

| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time |
|---|---|---|---|---|---|---|
| [signature] | 3/13/96 1400 | | | | [signature] | 3/14/96 0925 |

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/12/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/13/96 | Lab Project Number | : | 96-0741 |
| Date Prepared | : | 3/14/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/14/96 | Detection Limit | : | 0.056 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrate-N mg/L | Dilution Factor |
|---|---|---|---|---|
| X20226 | BE-MP22-01 | Water | 1.8 | 1 |
| X20227 | BE-MP42-01 | Water | 1.9 | 1 |
| X20228 | BE-MP11-01 | Water | 0.81 | 1 |
| X20229 | BE-MP44-01 | Water | 0.80 | 1 |
| Method Blank | (3/14/96) | Water | <0.056 | |

### Quality Assurance *

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20226 | Matrix Spike | 10.0 | 8.2 | 18.6 | 104 |
| X20226 | Matrix Spike Dup | 10.0 | 8.2 | 18.0 | 98 |
| MS/MSD RPD | | | | | 5.7 |

* = Quality assurance results reported as Nitrate ($NO_3$).

Analyst

Approved

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(303) 425-6021

## Anion Report

| | | | | |
|---|---|---|---|---|
| Date Sampled | : 3/12/96 | | Client Project ID. | : 722450.14020 |
| Date Received | : 3/13/96 | | Lab Project Number | : 96-0741 |
| Date Prepared | : 3/14/96 | | Method | : EPA 300.0 |
| Date Analyzed | : 3/14/96 | | Detection Limit | : 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Sulfate mg/L | Dilution Factor |
|---|---|---|---|---|
| X20226 | BE-MP22-01 | Water | 23.5 | 1 |
| X20227 | BE-MP42-01 | Water | 23.5 | 1 |
| X20228 | BE-MP11-01 | Water | 7.0 | 1 |
| X20229 | BE-MP44-01 | Water | 7.0 | 1 |
| Method Blank | (3/14/96) | Water | <0.25 | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result * (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20226 | Matrix Spike | 10.0 | 2.5 | 11.7 | 93 |
| X20226 | Matrix Spike Dup | 10.0 | 2.5 | 11.7 | 93 |
| MS/MSD RPD | | | | | 0.11 |

* = Value based on a 10X dilution factor.

Analyst

Approved

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(303) 425-6021

# Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/12/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/13/96 | Lab Project Number | : | 96-0741 |
| Date Prepared | : | 3/14/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/14/96 | Detection Limit | : | 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Chloride | | Dilution Factor |
|---|---|---|---|---|---|
| X20226 | BE-MP22-01 | Water | 72.2 | mg/L | 10 |
| X20227 | BE-MP42-01 | Water | 70.2 | mg/L | 10 |
| X20228 | BE-MP11-01 | Water | 18.0 | mg/L | 1 |
| X20229 | BE-MP44-01 | Water | 16.8 | mg/L | 1 |
| Method Blank | (3/14/96) | Water | <0.25 | mg/L | |

## Quality Assurance

| | | Spike Amount (mg/L) | Sample Result * (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20226 | Matrix Spike | 10.0 | 7.2 | 16.6 | 93 |
| X20226 | Matrix Spike Dup | 10.0 | 7.2 | 16.6 | 93 |
| MS/MSD RPD | | | | | 0 |

* = Value based on a 10X dilution factor.

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## Anion Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/12/96 | Client Project ID. | : 722450.14020 |
| Date Received | : 3/13/96 | Lab Project Number | : 96-0741 |
| Date Prepared | : 3/14/96 | Method | : EPA 300.0 |
| Date Analyzed | : 3/14/96 | Detection Limit | : 0.076 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrite-N mg/L | Dilution Factor |
|---|---|---|---|---|
| X20226 | BE-MP22-01 | Water | <0.076 | 1 |
| X20227 | BE-MP42-01 | Water | <0.076 | 1 |
| X20228 | BE-MP11-01 | Water | <0.076 | 1 |
| X20229 | BE-MP44-01 | Water | <0.076 | 1 |
| Method Blank | (3/14/96) | Water | <0.076 | |

### Quality Assurance *

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20226 | Matrix Spike | 10.0 | <0.25 | 9.5 | 95 |
| X20226 | Matrix Spike Dup | 10.0 | <0.25 | 8.9 | 89 |
| MS/MSD RPD | | | | | 5.9 |

* = Quality assurance results reported as Nitrite ($NO_2$).

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## Analysis Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/12/96 | Client Project ID. | : 722450.1420 |
| Date Received | : 3/13/96 | Lab Project Number | : 96-0741 |
| Date Prepared | : 3/18/96 | Method | : EPA 310.1 |
| Date Analyzed | : 3/18/96 | Detection Limit | : 5.0 mg $CaCO_3$/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Total Alkalinity (mg $CaCO_3$/L) | Dilution Factor |
|---|---|---|---|---|
| X20226 | BE-MP22-01 | Water | 181 | 1 |
| X20227 | BE-MP42-01 | Water | 186 | 1 |
| X20228 | BE-MP11-01 | Water | 104 | 1 |
| X20229 | BE-MP44-01 | Water | 103 | 1 |
| Method Blank | (3/18/96) | | <5.0 | |

### Quality Assurance

| Reference | True Value (mg$CaCO_3$/L) | Result (mg$CaCO_3$/L) | % Recovery |
|---|---|---|---|
| ERA Alkalinity Lot # 0814-95-06 | 120 | 116 | 97 |

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## Analysis Report

| | | | | |
|---|---|---|---|---|
| Date Sampled | : 3/12/96 | Client Project ID. | : | 722450.1420 |
| Date Received | : 3/13/96 | Lab Project Number | : | 96-0741 |
| Date Prepared | : 3/20/96 | Method | : | Standard Method 4500-$NH_3F$ |
| Date Analyzed | : 3/20/96 | Detection Limit | : | 0.80 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Ammonia-N | Dilution Factor |
|---|---|---|---|---|
| X20226 | BE-MP22-01 | Water | <0.80 mg/L | 1 |
| X20227 | BE-MP42-01 | Water | <0.80 mg/L | 1 |
| X20228 | BE-MP11-01 | Water | <0.80 mg/L | 1 |
| X20229 | BE-MP44-01 | Water | <0.80 mg/L | 1 |
| Method Blank | (3/20/96) | | <0.80 mg/L | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20229 | BE-MP44-01 Matrix Spike | 10.0 | <0.80 | 9.9 | 99 |
| X20229 | BE-MP44-01 Matrix Spike Dup | 10.0 | <0.80 | 9.9 | 99 |
| MS/MSD RPD | | | | | 0.0 |

Brad Cowell

Analyst

Approved

Evergreen Analytical, Inc.
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# RSK-175 Gas Method
## Methane LCS Report Form

| | | | |
|---|---|---|---|
| LCS No. | : LCS032596 | EPA Method No. | : RSKSOP-175 |
| Date Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Method Blank | : GB032596 |
| E.A. LCS Source No. | : 1723 | Lab File No. | : GAS0325008 |

| Compound | Spike Added (ug) | Method Blank Concentration (ug) | LCS Concentration (ug) | LCS %REC | QC Limits %REC |
|---|---|---|---|---|---|
| Methane Gas | 500 | 0 | 407 | 81 | 67-85 |

Spike Recovery: 0 out of (1) outside limits.

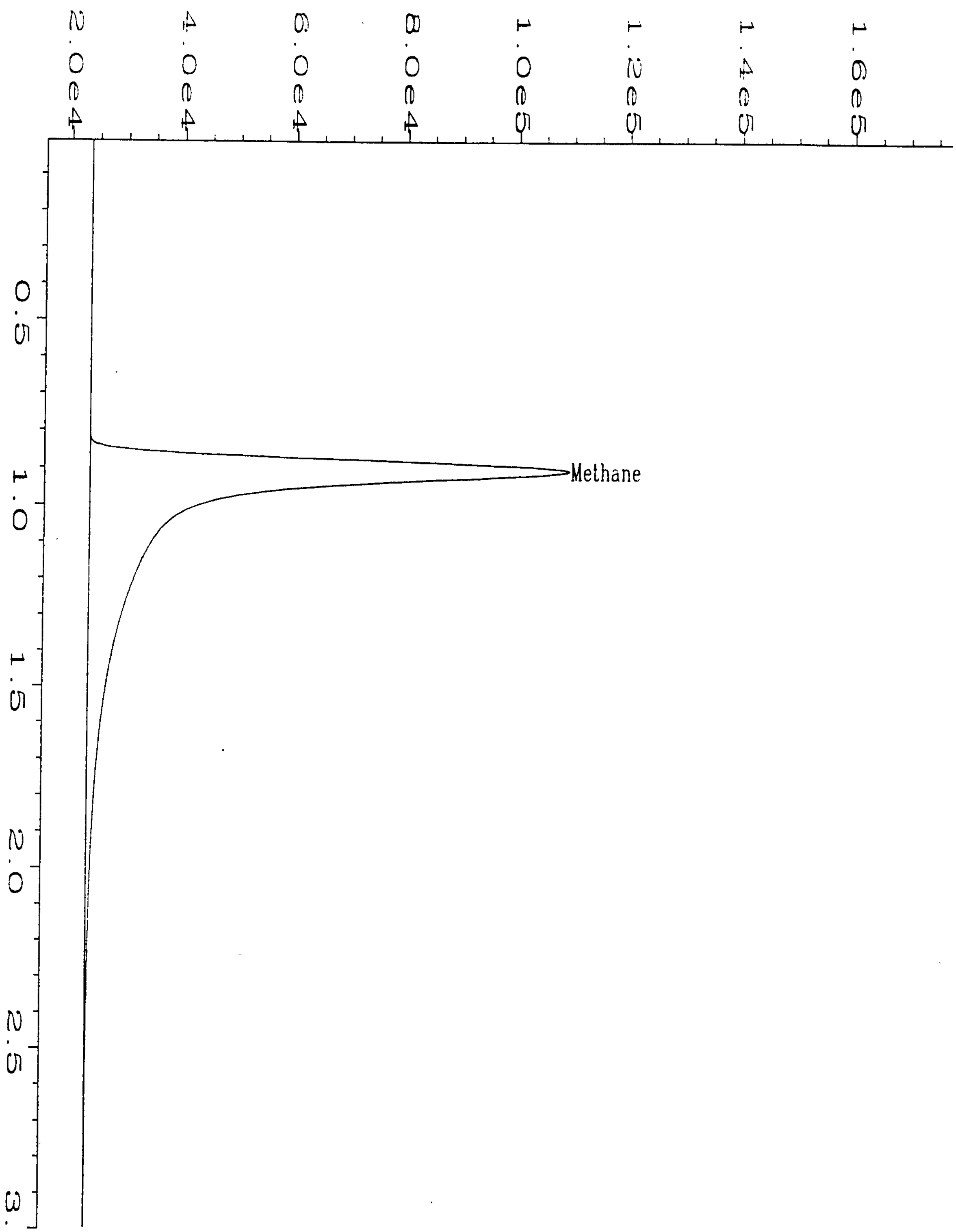
Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

Approved

LCS0325.XLS; 3/25/96




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0325\008R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : LCS032596;Gas
Run Time Bar Code:
Acquired on : 25 Mar 96 09:57 AM
Report Created on: 25 Mar 96 10:06 AM
Last Recalib on : 25 MAR 96 09:44 AM
Multiplier : 1
Sample Info : Laboratory Control Sample
Displaced 4ml of deionized water in 43ml vial with 1%
methane gas(#1723), shook for 5 min, and injected 50ul

Page Number : 1
Vial Number : 8
Injection Number : 1
Sequence Line : 1
Instrument Method: GAS.MTH
Analysis Method : GAS0325.M
Sample Amount : 0
ISTD Amount :

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(303) 425-6021

## Methane Report Form

| | | | |
|---|---|---|---|
| [redacted] Sample Number | : BE-MP44-01 | Client Project No. | : 722450.14020 |
| [redacted]ample Number | : X20229Dup | Lab Project No. | : 96-0741 |
| Date Sampled | : 3/12/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/13/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Lab File No. | : GAS0325014 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 0.164 | 0.002 |

| | | | | |
|---|---|---|---|---|
| ᄀperature | : 72.1 F | Saturation Concentration | Meth | 0.03944152 |
| ount Injected | : 0.5 ml | Concentration in Head Space | Meth | 0.124248158 |
| To[redacted]Volume of Sample | : 43 ml | | | |
| H[redacted]pace created | : 4 ml | | | |
| M[redacted]ne Area | : 917.193 ug | | | |
| Atomic weight(Methane) | : 16 g | | | |

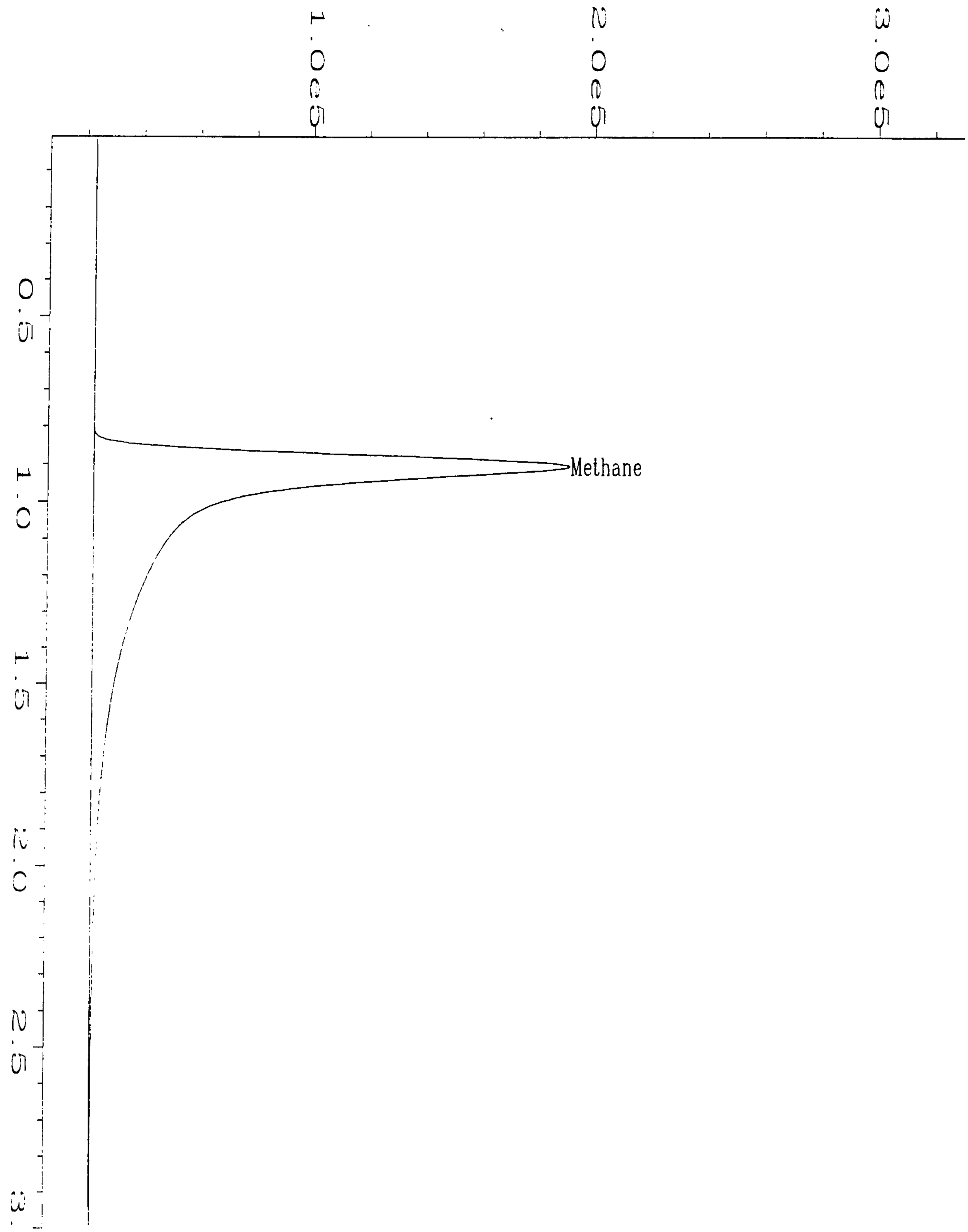
QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

Analyst

Approved

AF0741.XLS




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0325\014R0101.D | | | | |
| Operator | : Bill Michener | Page Number | : 1 | | |
| Instrument | : ALCGAS | Vial Number | : 14 | | |
| Sample Name | : X20229Dup;1 | Injection Number | : 1 | | |
| Run Time Bar Code | : | Sequence Line | : 1 | | |
| Acquired on | : 25 Mar 96 12:29 PM | Instrument Method | : GAS.MTH | | |
| Report Created on | : 25 Mar 96 01:42 PM | Analysis Method | : GAS0325.M | | |
| Last Recalib on | : 25 MAR 96 09:44 AM | Sample Amount | : 0 | | |
| Multiplier | : 1 | ISTD Amount | : | | |
| Sample Info | : 96-0741;BE-MP44-01;Water | | | | |

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## Methane Report Form

| | | | |
|---|---|---|---|
| [redacted] Sample Number | : BE-MP44-01 | Client Project No. | : 722450.14020 |
| [redacted]ample Number | : X20229 | Lab Project No. | : 96-0741 |
| Date Sampled | : 3/12/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/13/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Lab File No. | : GAS0325013 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 0.167 | 0.002 |

| | | |
|---|---|---|
| mperature | : | 72.1 F |
| .iount Injected | : | 0.5 ml |
| T[redacted] Volume of Sample | : | 43 ml |
| [redacted]pace created | : | 4 ml |
| M[redacted]ane Area | : | 937.383 ug |
| Atomic weight(Methane) | : | 16 g |

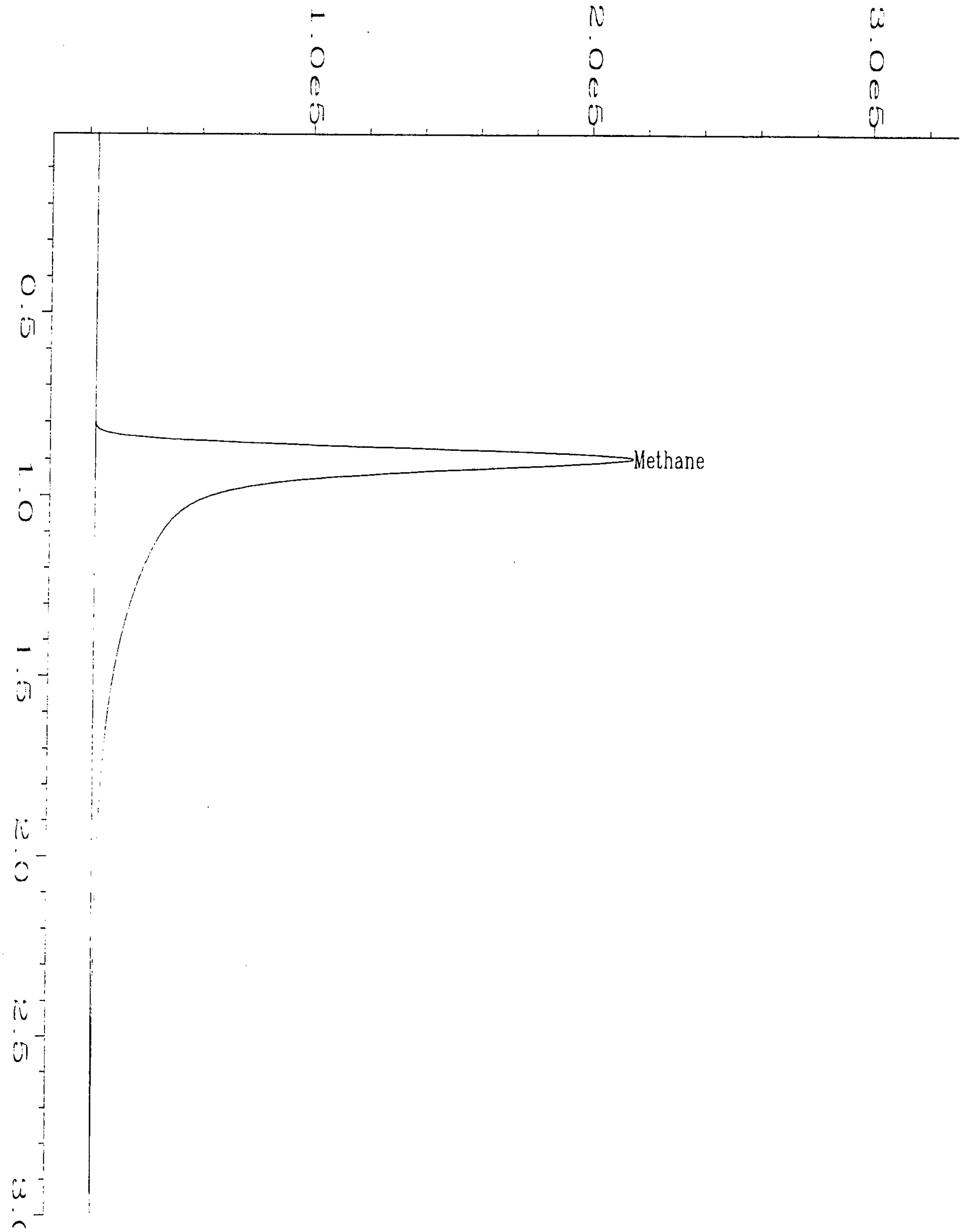
| | | |
|---|---|---|
| Saturation Concentration | Meth | 0.040309739 |
| Concentration in Head Space | Meth | 0.12698321 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

Approved

AF0741.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0325\013R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X20229;1
Run Time Bar Code:
Acquired on : 25 Mar 96 12:20 PM
Report Created on: 25 Mar 96 01:42 PM
Last Recalib on : 25 MAR 96 09:44 AM
Multiplier : 1
Sample Info : 96-0741;BE-MP44-01;Water

Page Number : 1
Vial Number : 13
Injection Number : 1
Sequence Line : 1
Instrument Method: GAS.MTH
Analysis Method : GAS0325.M
Sample Amount : 0
ISTD Amount :

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## Methane Report Form

| | | | |
|---|---|---|---|
| [redacted]t Sample Number | : BE-MP11-01 | Client Project No. | : 722450.14020 |
| [redacted]ample Number | : X20228 | Lab Project No. | : 96-0741 |
| Date Sampled | : 3/12/96 | Dilution Factor | : 2.00 |
| Date Received | : 3/13/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Lab File No. | : GAS0325012 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 0.176 | 0.004 |

| | | | | |
|---|---|---|---|---|
| nperature | : 72.2 F | Saturation Concentration | Meth | 0.042503335 |
| .nount Injected | : 0.25 ml | | | |
| T[redacted]Volume of Sample | : 43 ml | Concentration in Head Space | Meth | 0.133868262 |
| [redacted]pace created | : 4 ml | | | |
| Me[redacted]ane Area | : 494.197 ug | | | |

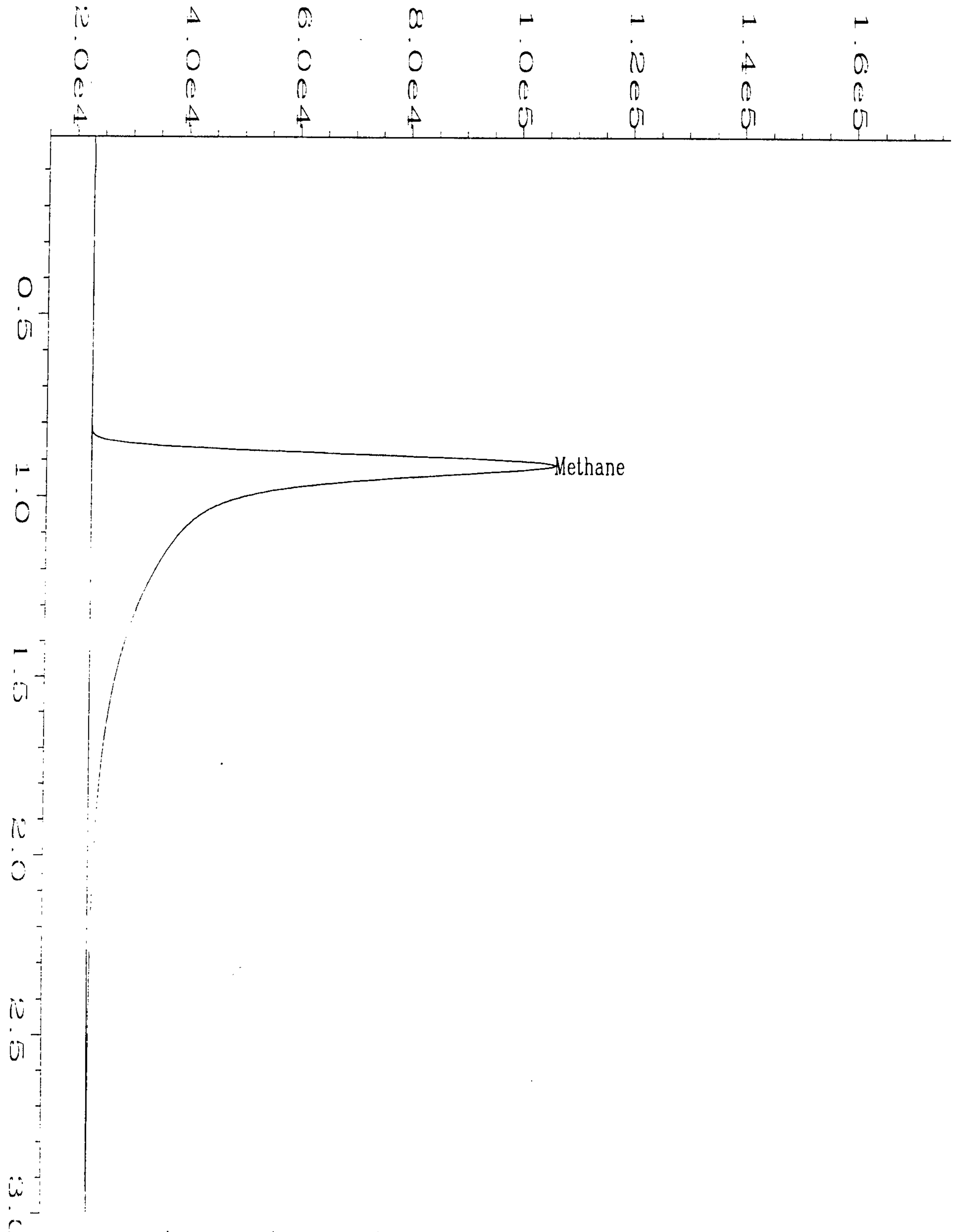
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

Approved

AF0741.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0325\012R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X20228;2
Run Time Bar Code:
Acquired on : 25 Mar 96 12:16 PM
Report Created on: 25 Mar 96 01:42 PM
Last Recalib on : 25 MAR 96 09:44 AM
Multiplier : 1
Sample Info : 96-0741;BE-MP11-01;Water

Page Number : 1
Vial Number : 12
Injection Number : 1
Sequence Line : 1
Instrument Method: GAS.MTH
Analysis Method : GAS0325.M
Sample Amount : 0
ISTD Amount :

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## Methane Report Form

| | | | |
|---|---|---|---|
| [redacted] Sample Number | : BE-MP42-01 | Client Project No. | : 722450.14020 |
| [redacted]ample Number | : X20227 | Lab Project No. | : 96-0741 |
| Date Sampled | : 3/12/96 | Dilution Factor | : 20.00 |
| Date Received | : 3/13/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Lab File No. | : GAS0325011 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 0.22 | 0.04 |

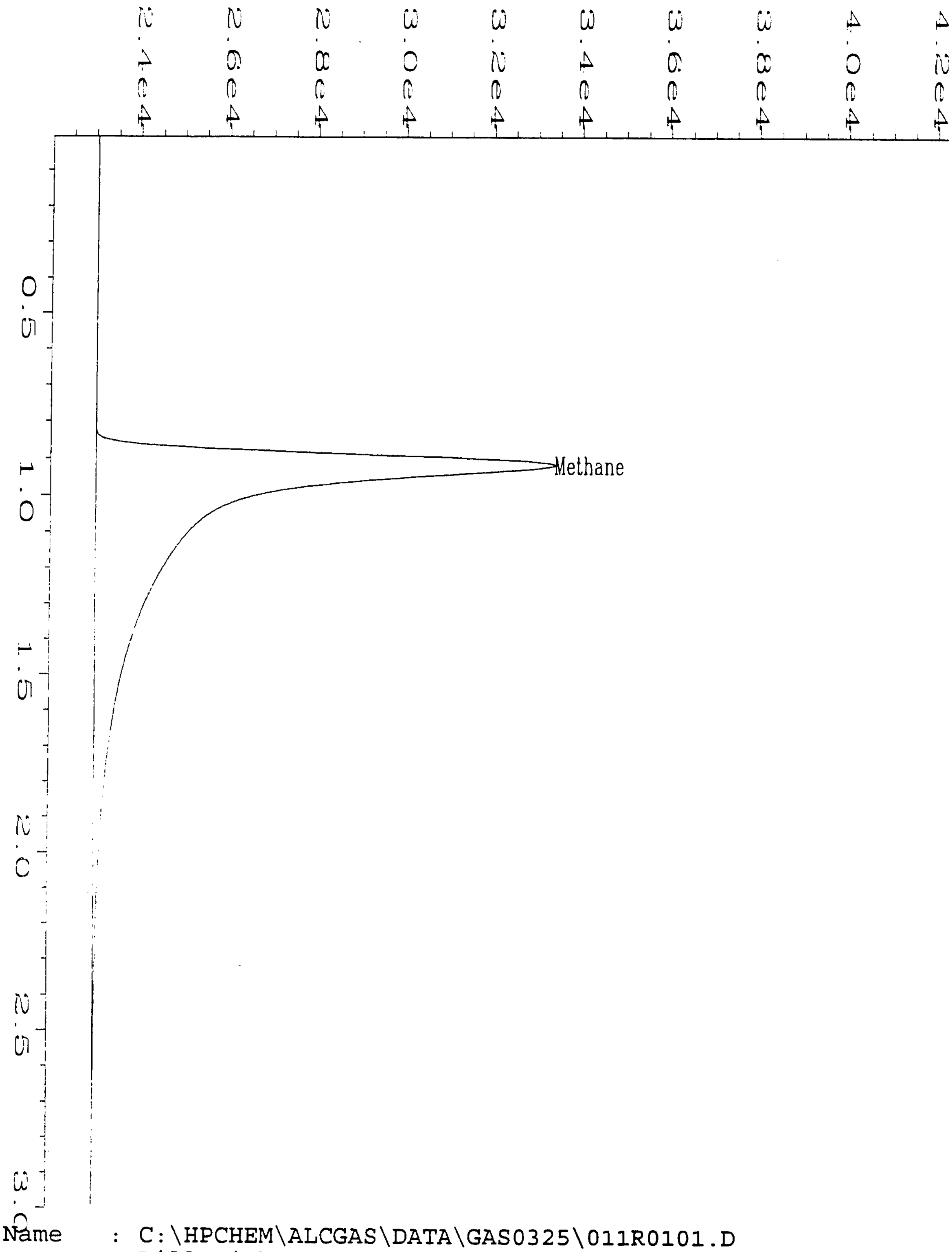
| | | |
|---|---|---|
| nperature | : | 72.6 F |
| . ..nount Injected | : | 0.025 ml |
| T[redacted]Volume of Sample | : | 43 ml |
| [redacted]pace created | : | 4 ml |
| Methane Area | : | 61.087 ug |
| Atomic weight(Methane) | : | 16 g |

| | | |
|---|---|---|
| Saturation Concentration | Meth | 0.052537778 |
| Concentration in Head Space | Meth | 0.165348271 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]
Analyst

Approved




| | | | |
|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0325\011R0101.D | | |
| Operator | : Bill Michener | Page Number | : 1 |
| Instrument | : ALCGAS | Vial Number | : 11 |
| Sample Name | : X20227;20 | Injection Number | : 1 |
| Run Time Bar Code: | | Sequence Line | : 1 |
| Acquired on | : 25 Mar 96 12:04 PM | Instrument Method | : GAS.MTH |
| Report Created on | : 25 Mar 96 01:42 PM | Analysis Method | : GAS0325.M |
| Last Recalib on | : 25 MAR 96 09:44 AM | Sample Amount | : 0 |
| Multiplier | : 1 | ISTD Amount | : |
| Sample Info | : 96-0741;BE-MP42-01;Water | | |

EVERGREEN ANALYTICAL, INC.
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Methane Report Form

| | | | |
|---|---|---|---|
| [redacted] Sample Number | : BE-MP22-01 | Client Project No. | : 722450.14020 |
| [redacted]ample Number | : X20226 | Lab Project No. | : 96-0741 |
| Date Sampled | : 3/12/96 | Dilution Factor | : 20.00 |
| Date Received | : 3/13/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/25/96 | Matrix | : Water |
| Date Analyzed | : 3/25/96 | Lab File No. | : GAS0325010 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 0.20 | 0.04 |

| | | | | |
|---|---|---|---|---|
| nperature | : 71.2 F | Saturation Concentration | Meth | 0.048592736 |
| iount Injected | : 0.025 ml | | | |
| T[redacted]Volume of Sample | : 43 ml | Concentration in Head Space | Meth | 0.153335846 |
| K[redacted]pace created | : 4 ml | | | |
| M[redacted]ane Area | : 56.5 ug | | | |

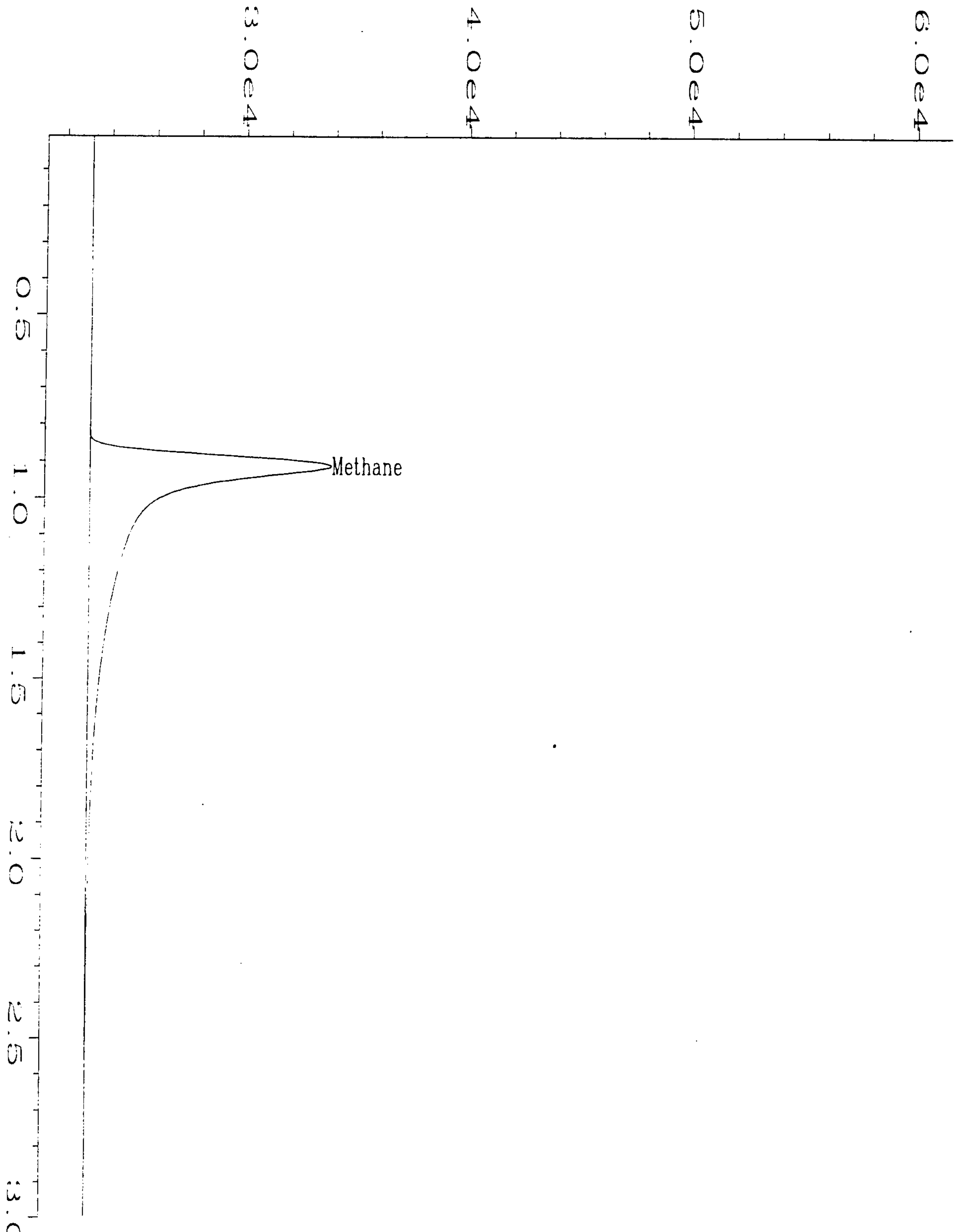
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted] Analyst

Approved

AF0741.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0325\010R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X20226;20
Run Time Bar Code:
Acquired on : 25 Mar 96 11:30 AM
Report Created on: 25 Mar 96 01:41 PM
Last Recalib on : 25 MAR 96 09:44 AM
Multiplier : 1
Sample Info : 96-0741;BE-MP22-01;Water

Page Number : 1
Vial Number : 10
Injection Number : 1
Sequence Line : 1
Instrument Method: GAS.MTH
Analysis Method : GAS0325.M
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

# Methane Report Form
## Method Blank Report

| | | | |
|---|---|---|---|
| Method Blank Number | : GB032596 | Client Project No. | : 722450.14020 |
| Date Extracted/Prepared | : 3/25/96 | Lab Project No. | : 96-0741 |
| Date Analyzed | : 3/25/96 | Dilution Factor | : 1.00 |
| | | Method | : RSKSOP-175 |
| | | Matrix | : Water |
| | | Lab File No. | : GAS0325002 |

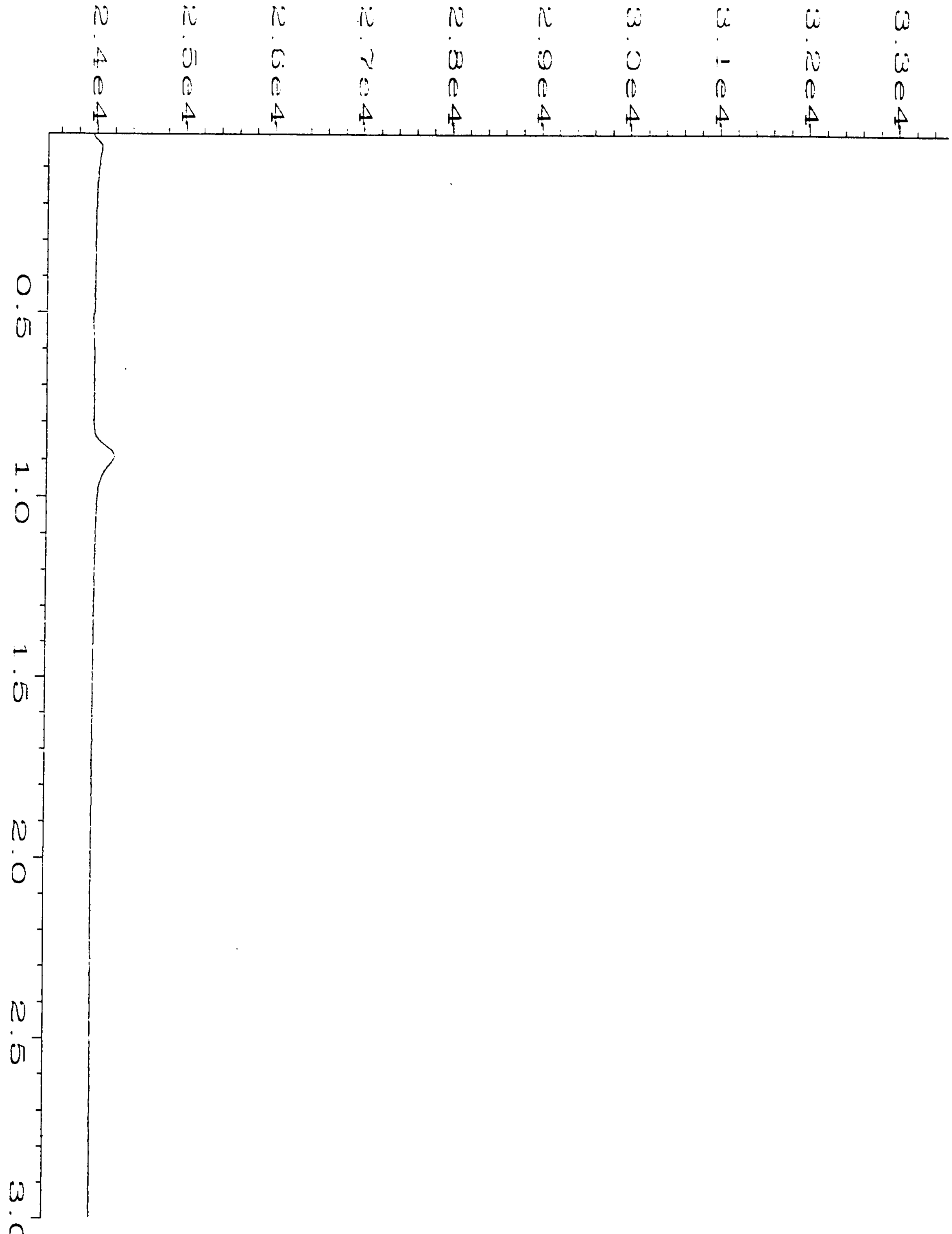
| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF0741.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0325\002R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : GB032596
Run Time Bar Code:
Acquired on : 25 Mar 96 08:51 AM
Report Created on: 25 Mar 96 09:45 AM
Last Recalib on : 25 MAR 96 09:44 AM
Multiplier : 1
Sample Info : Gas Method Blank
Displaced 4ml of deionized water in 43ml vial with Helium,
shook for 5 min. and injected 500ul

Page Number : 1
Vial Number : 2
Injection Number : 1
Sequence Line : 1
Instrument Method: GAS.MTH
Analysis Method : GAS0325.M
Sample Amount : 0
ISTD Amount :

**Evergreen Analytical Sample Receipt/Check-in Rec---**

1154090954

Date & Time Rec'd: 3/13/96 0915 Shipped Via: Fed. X
(Airbill # if applicable)

Client : Parsons ES

Client Project ID(s):

EAL Project #(s): 96- 0741 EAL Cooler(s): Y N

| | | | | | |
|---|---|---|---|---|---|
| Cooler# | 264 | | | | |
| Ice packs | Y N | Y N | Y N | Y N | Y N |
| Temperature °C | 10 | | | | |

↳ Msrd on temp blank

| | Y | N | N/A |
|---|---|---|---|
| 1. Custody seal(s) present: | X | | |
| Seals on cooler intact | X | | |
| Seals on bottle intact | | | X |
| 2. Chain of Custody present: | X | | |
| 3. Samples Radioactive: (Comment on COC if > 0.5mr/h) | | X | |
| 4. Containers broken or leaking: (Comment on COC if Y) | | X | |
| 5. Containers labeled: | X | | |
| 6. COC agrees w/ bottles received: (Comment on COC if N) | X | | |
| 7. COC agrees w/ labels: (Comment on COC if N) | X | | |
| 8. Headspace in vials-waters only: (Comment on COC if Y) | | X | |
| 9. VOA samples preserved: | X | | |
| 10. pH measured on metals, cyanide or phenolics*: | | | X |

List discrepancies

*Non-EAL provided containers only, water samples only.

| | Y | N |
|---|---|---|
| 11. Metal samples present: | | X |
| Total ____ , Dissolved ____ , TCLP ____ | | |
| D or PD to be filtered: | | |
| T,TR,D,PD to be Preserved: | | |
| 12. Short holding times: | X | |
| Specify parameters $NO_2/NO_3$ | | |
| 13. Multi-phase sample(s) present: | | X |
| 14. COC signed w/ date/time: | X | |

Comments:

(Additional comments on back)

Custodian Signature/Date: WJM 3/13/96

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Total Organic Carbon

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/12/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/13/96 | Lab Project Number | : | 96-0741 |
| Date Prepared | : | 3/14/96 | Method | : | EPA 415.1 |
| Date Analyzed | : | 3/14/96 | Detection Limit | : | 1.0 mg C/L |

| Evergreen Sample # | Client Sample ID. | Matrix | TOC mg C/L | Dilution Factor |
|---|---|---|---|---|
| X20226 | BE-MP22-01 | Water | 4.3 | 1 |
| X20227 | BE-MP42-01 | Water | 4.6 | 1 |
| X20228 | BE-MP11-01 | Water | 2.1 | 1 |
| X20229 | BE-MP44-01 | Water | 2.2 | 1 |
| Method Blank | (3/14/96) | | <1.0 | |

## Quality Assurance

| | | Spike Amount (mgC/L) | Sample Result (mgC/L) | Spike Result (mgC/L) | % Recovery |
|---|---|---|---|---|---|
| X20226 | BE-MP22-01 Matrix Spike | 10.0 | 4.3 | 15.2 | 109 |
| X20226 | BE-MP22-01 Matrix Spike Dup | 10.0 | 4.3 | 14.5 | 102 |
| MS/MSD RPD | | | | | 6.2 |

Analyst

Approved

# Evergreen Analytical Sample Log Sheet

**Project # 96-0741**

**Date(s) Sampled:** 03/12/96 COC

**Date Due:** 03/27/96

**te Received:** 03/13/96 0915

**Holding Time(s):** 03/14-$NO_2$,$NO_3$,
3/26-ALKALINITY

**Client Project I.D.** 722450.14020

**Rush** STANDARD

**Client:** PARSONS ENGINEERING SCIENCE, INC.

**Address:** 1301 MARINA VILLAGE PKWY #200
ALAMEDA, CA 94501

**Contact:** MICHAEL PHELPS

**Phone** #510-769-0100 **Fax** #510-769-9244

**Cooler Return** N/A

**E.A. Cooler #** N/A

**Airbill #** FEDEX 1154090954

**Client P.O.**

**Special Invoicing/Billing**

**Special Instructions**

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X20226A | BE-MP22-01 | TOC | W | 125A | CL4 |
| X20227A | BE-MP42-01 | TOC | W | 125A | CL4 |
| X20228A | BE-MP11-01 | TOC | W | 125A | CL4 |
| X20229A | BE-MP44-01 | TOC | W | 125A | CL4 |
| 226B | BE-MP22-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | CL4 |
| X20227B | BE-MP42-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | CL4 |
| X 8B | BE-MP11-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | CL4 |
| X20229B | BE-MP44-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | CL4 |
| X20226C | BE-MP22-01 | AMMONIA | W | 500P | CL4 |
| X20227C | BE-MP42-01 | AMMONIA | W | 500P | CL4 |
| X20228C | BE-MP11-01 | AMMONIA | W | 500P | CL4 |
| X20229C | BE-MP44-01 | AMMONIA | W | 500P | CL4 |
| X20226D | BE-MP22-01 | ALKALINITY | W | 125P | CL4 |
| X20227D | BE-MP42-01 | ALKALINITY | W | 125P | CL4 |
| X20228D | BE-MP11-01 | ALKALINITY | W | 125P | CL4 |
| X20229D | BE-MP44-01 | ALKALINITY | W | 125P | CL4 |
| X20226E-G | BE-MP22-01 | METHANE | W | 40V | 2 |
| X20227E-G | BE-MP42-01 | METHANE | W | 40V | 2 |
| X20228E-G | BE-MP11-01 | METHANE | W | 40V | 2 |
| X20229E-G | BE-MP44-01 | METHANE | W | 40V | 2 |

R=Sample to be returned

te GC/MS ___ GC X Metals ___ Wet Chem X HPLC ___ SxPrep ___

T

SxRec C QA/QC C Acctg C File Orig

**Page 1 of 1 Page(s)**

**Custodian/Date:** MPM 3/17/96 Pm 3/18/9

# CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

**Evergreen Analytical Inc.**
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 1

COMPANY Parsons ES
ADDRESS 1301 Marina Village Pkwy St200
CITY Alameda STATE CA ZIP 94501
PHONE# 510 769 0100 FAX # 510 769 9244 FAX RESULTS Y / N

CLIENT CONTACT (print) Michael Phelps
PROJECT I.D.
EAL. QUOTE # P.O.#
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify)
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Tania Turpin
(print) Tania Turpin
Michael Friedman
Evergreen Analytical Cooler No.
Cooler Received

Please **PRINT** all information:

EAL use only
Do not write in shaded area

EAL Project # 96-0741
Custodian wym

| CLIENT SAMPLE IDENTIFICATION | DATE SAMPLED | TIME | No. of Containers | MATRIX: Water-Drinking/Discharge/Ground (circle) | Soil / Solid | Oil / Sludge | TCLP VOA/BNA/Pest/Herb/Metals (circle) | VOA 8260/624/524.2 (circle) | ~~8270/625 (circle)~~ TOC | Pesticides 8080/608 (circle) | Pest/PCBs 8080/608/508 (circle) | Herbicides 8150/515 (circle) | PCB Screen | BTEX 8020/602 (circle)/MTBE (circle) | TRPH 418.1/Oil & Grease 413.1 (circle) | TVPH 8015mod. (Gasoline) | TEPH 8015mod. (Diesel) | Total Metals-DW / NPDES / SW846 (circle & list metals below) | Dissolved Metals - DW / SW846 (circle & list metals below) | Anions (Nitrate, Nitrite, Chloride, Sulfate) | Dissolved Ammonia | Alkalinity | Methane | | | | EAL Sample No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP22-Ø1 | 3/12/96 | 1120 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | | X20226 |
| BE-MP42-Ø1 | 3/12/96 | 1130 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | | 27 |
| BE-MP11-Ø1 | 3/12/96 | 1330 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | | 28 |
| BE-MP44-Ø1 | 3/12/96 | 1345 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | | 29 |
| HT: | | | | | | | | | A | | | | | | | | | | | B | C | D | E-G | | | | Location 2, CL4 |
| DD: | | | | | | | | | 125A | | | | | | | | | | | 125 P | 500 P | 125 P | 40 V | | | | Container Size ← |

Instructions:

| Relinqu[redacted]ature) | Date/Time | Received by: (Signature) | [redacted]m | [R]elinquished by: (Signature) | Date/Time | Received by: (Sign[redacted] | Date/Time |
|---|---|---|---|---|---|---|---|
| Tania Turpin | 3/12/96 1600 | | | | | [signature] | 3/13/96 0915 |

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | |
|---|---|---|---|---|
| Date Sampled | : 3/11/96 | | Client Project ID. | : 722450.14020 |
| Date Received | : 3/12/96 | | Lab Project Number | : 96-0706 |
| Date Prepared | : 3/12/96 | | Method | : EPA 300.0 |
| Date Analyzed | : 3/12/96 | | Detection Limit | : 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Sulfate mg/L | Dilution Factor |
|---|---|---|---|---|
| X20031 | BE-MP15-01 | Water | 11.4 | 1 |
| X20032 | BE-MP17-01 | Water | 3.4 | 1 |
| X20033 | BE-MP-8-01 | Water | 467 | 50 |
| X20034 | BE-MP-41-01 | Water | 458 | 50 |

Method Blank ( 3/12/96) <0.25

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20032 | BE-MP17-01 Matrix Spike | 10.0 | 3.4 | 13.0 | 95 |
| X20032 | BE-MP17-01 Matrix Spike Dup | 10.0 | 3.4 | 12.3 | 89 |
| MS/MSD RPD | | | | | 7.0 |

Analyst

Approved

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | |
|---|---|---|---|---|
| Date Sampled | : 3/11/96 | | Client Project ID. | : 722450.14020 |
| Date Received | : 3/12/96 | | Lab Project Number | : 96-0706 |
| Date Prepared | : 3/12/96 | | Method | : EPA 300.0 |
| Date Analyzed | : 3/12/96 | | Detection Limit | : 0.076 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrite-N mg/L | Dilution Factor |
|---|---|---|---|---|
| X20031 | BE-MP15-01 | Water | <0.076 | 1 |
| X20032 | BE-MP17-01 | Water | <0.076 | 1 |
| X20033 | BE-MP-8-01 | Water | <0.76** | 10 |
| X20034 | BE-MP-41-01 | Water | <0.76** | 10 |

Method Blank ( 3/12/96) <0.076

### Quality Assurance *

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20032 | BE-MP17-01 Matrix Spike | 10.0 | <0.25 | 9.7 | 97 |
| X20032 | BE-MP17-01 Matrix Spike Dup | 10.0 | <0.25 | 8.9 | 89 |
| MS/MSD RPD | | | | | 8.0 |

* = Quality assurance results reported as Nitrite ($NO_2$).

** = Increased detection limit due to Matrix Interference.

Analyst

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**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/11/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/12/96 | Lab Project Number | : | 96-0706 |
| Date Prepared | : | 3/12/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/12/96 | Detection Limit | : | 0.056 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrate-N mg/L | Dilution Factor |
|---|---|---|---|---|
| X20031 | BE-MP15-01 | Water | 0.18 | 1 |
| X20032 | BE-MP17-01 | Water | 2.5 | 1 |
| X20033 | BE-MP-8-01 | Water | 148 | 50 |
| X20034 | BE-MP-41-01 | Water | 141 | 50 |
| Method Blank | ( 3/12/96) | | <0.056 | |

## Quality Assurance *

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20032 | BE-MP17-01 Matrix Spike | 10.0 | 11.2 | 21.4 | 102 |
| X20032 | BE-MP17-01 Matrix Spike Dup | 10.0 | 11.2 | 21.0 | 98 |
| MS/MSD RPD | | | | | 4.0 |

* = Quality assurance results reported as Nitrate ($NO_3$).

Analyst

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(303) 425-6021

## Analysis Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : 3/11/96 | | Client Project ID. | : | 722450.14020 |
| Date Received | : 3/12/96 | | Lab Project Number | : | 96-0706 |
| Date Prepared | : 3/18/96 | | Method | : | Standard Method 4500-$NH_3$F |
| Date Analyzed | : 3/18/96 | | Detection Limit | : | 0.80 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Ammonia-N | Dilution Factor |
|---|---|---|---|---|
| X20031 | BE-MP15-01 | Water | <0.80 mg/L | 1 |
| X20032 | BE-MP17-01 | Water | <0.80 mg/L | 1 |
| X20033 | BE-MP-8-01 | Water | 3.3 mg/L | 1 |
| X20034 | BE-MP-41-01 | Water | 1.9 mg/L | 1 |
| Method Blank | (3/18/96) | | <0.80 mg/L | |

## Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20031 | BE-MP15-01 Matrix Spike | 10.0 | <0.80 | 9.5 | 95 |
| X20031 | BE-MP15-01 Matrix Spike Dup | 10.0 | <0.80 | 9.4 | 94 |
| MS/MSD RPD | | | | | 1.2 |

Analyst

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(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/11/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/12/96 | Lab Project Number | : | 96-0706 |
| Date Prepared | : | 3/12/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/12/96 | Detection Limit | : | 0.25 mg/L |

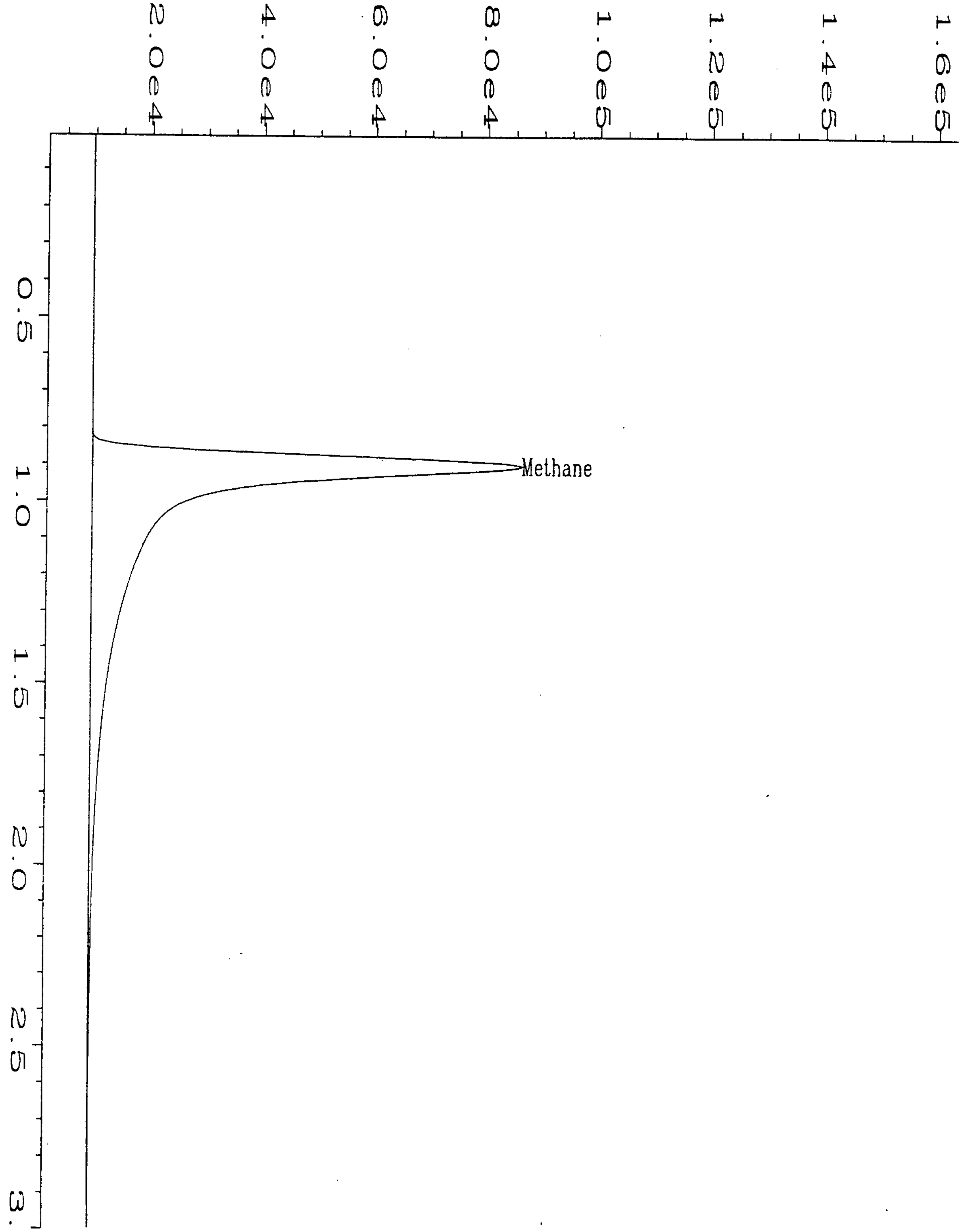
| Evergreen Sample # | Client Sample ID. | Matrix | Chloride mg/L | Dilution Factor |
|---|---|---|---|---|
| X20031 | BE-MP15-01 | Water | 84.4 | 10 |
| X20032 | BE-MP17-01 | Water | 20.3 | 1 |
| X20033 | BE-MP-8-01 | Water | 925 | 50 |
| X20034 | BE-MP-41-01 | Water | 885 | 50 |
| Method Blank | ( 3/12/96) | | <0.25 | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X20032 | BE-MP17-01 Matrix Spike | 10.0 | 20.3 | 29.7 | 94 |
| X20032 | BE-MP17-01 Matrix Spike Dup | 10.0 | 20.3 | 30.0 | 97 |
| MS/MSD RPD | | | | | 3.3 |

Analyst

Approved




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\038R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : LCS031396;Gas
Time Bar Code:
Acquired on : 13 Mar 96 11:23 AM
Report Created on: 13 Mar 96 11:26 AM
Last Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1

Page Number : 1
Vial Number : 38
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Analysis Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/11/96 | Client Project ID. | : 722450.14020 |
| Date Received | : 3/12/96 | Lab Project Number | : 96-0706 |
| Date Prepared | : 3/18/96 | Method | : EPA 310.1 |
| Date Analyzed | : 3/18/96 | Detection Limit | : 5.0 mg $CaCO_3$/L |

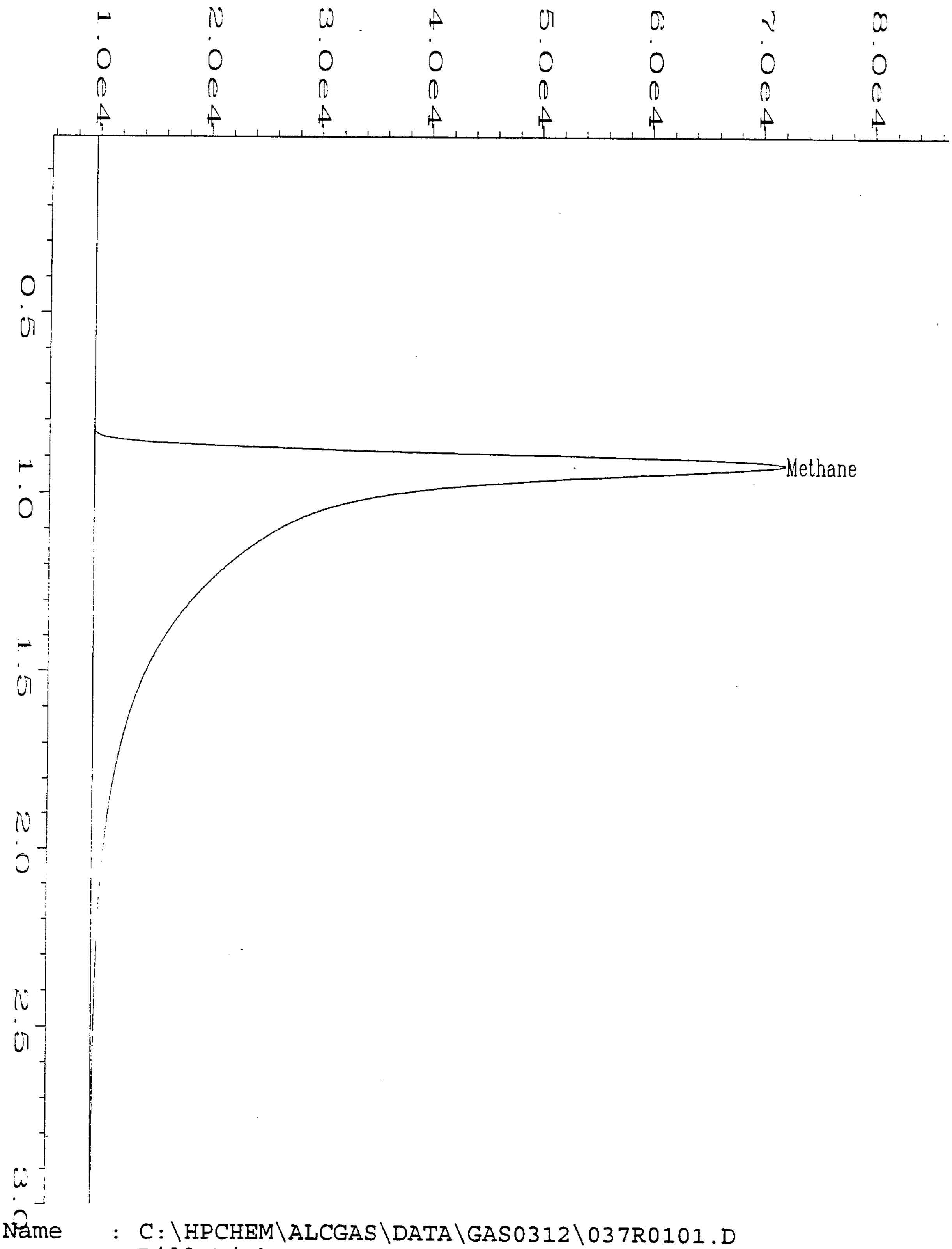
| Evergreen Sample # | Client Sample ID. | Matrix | Total Alkalinity (mg $CaCO_3$/L) | Dilution Factor |
|---|---|---|---|---|
| X20032 | BE-MP17-01 | Water | 68.7 | 1 |
| X20033 | BE-MP-8-01 | Water | 1220 | 1 |
| X20034 | BE-MP-41-01 | Water | 1250 | 1 |
| Method Blank | (3/18/96) | | <5.0 | |

### Quality Assurance

| Reference | True Value (mg$CaCO_3$/L) | Result (mg$CaCO_3$/L) | % Recovery |
|---|---|---|---|
| ERA Alkalinity Lot # 0814-95-06 | 120 | 116 | 97 |

Analyst

Approved




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : | C:\HPCHEM\ALCGAS\DATA\GAS0312\037R0101.D | | | |
| Operator | : | Bill Michener | Page Number | : | 1 |
| Instrument | : | ALCGAS | Vial Number | : | 37 |
| Sample Name | : | X20034;50 | Injection Number | : | 1 |
| [illegible] Time Bar Code | : | | Sequence Line | : | 1 |
| [illegible]uired on | : | 13 Mar 96 11:14 AM | Instrument Method | : | METHANE.MTH |
| Re[illegible]t Created on | : | 13 Mar 96 11:21 AM | Analysis Method | : | GAS0313.MTH |
| L[illegible] Recalib on | : | 13 MAR 96 08:33 AM | Sample Amount | : | 0 |
| Mu[illegible]iplier | : | 1 | ISTD Amount | : | |
| Sample Info | : | 96-0706;BE-MP-41-01;Water | | | |

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

## RSK-175 Gas Method
## Methane LCS Report Form

| | | | |
|---|---|---|---|
| LCS No. | : LCS031396 | EPA Method No. | : RSKSOP-175 |
| Date Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Method Blank | : GB031396 |
| E.A. LCS Source No. | : 1723 | Lab File No. | : GAS0312038 |

| Compound | Spike Added (ug) | Method Blank Concentration (ug) | LCS Concentration (ug) | LCS %REC | QC Limits %REC |
|---|---|---|---|---|---|
| Methane Gas | 500 | 0 | 361 | 72 | 67-85 |

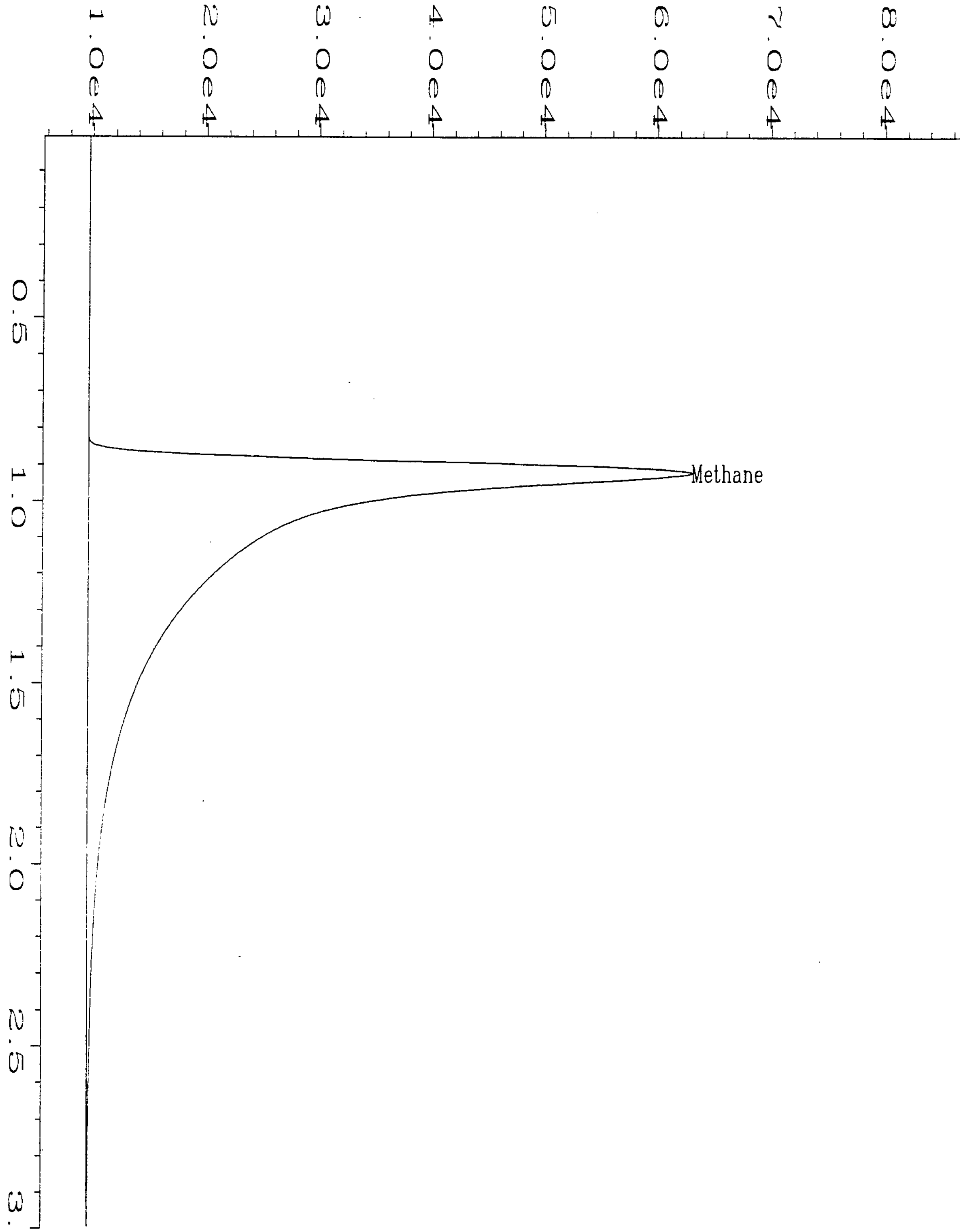
Spike Recovery: 0 out of (1) outside limits.

Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

K Hellman
Approved




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\036R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X20033;50
Time Bar Code:
[illegible]uired on : 13 Mar 96 11:10 AM
R[illegible]t Created on: 13 Mar 96 11:21 AM
L[illegible] Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1
Sample Info : 96-0706;BE-MP8-01;Water

Page Number : 1
Vial Number : 36
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP-41-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X20034 | Lab Project No. | : 96-0706 |
| Date Sampled | : 3/11/96 | Dilution Factor | : 50.00 |
| Date Received | : 3/12/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312037 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 3.9 | 0.1 |

| | | |
|---|---|---|
| Temperature | : | 72.2 F |
| Amount Injected | : | 0.01 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 440.268 ug |

| | | |
|---|---|---|
| Saturation Concentration | Meth | 0.94662 |
| Concentration in Head Space | Meth | 2.98149 |

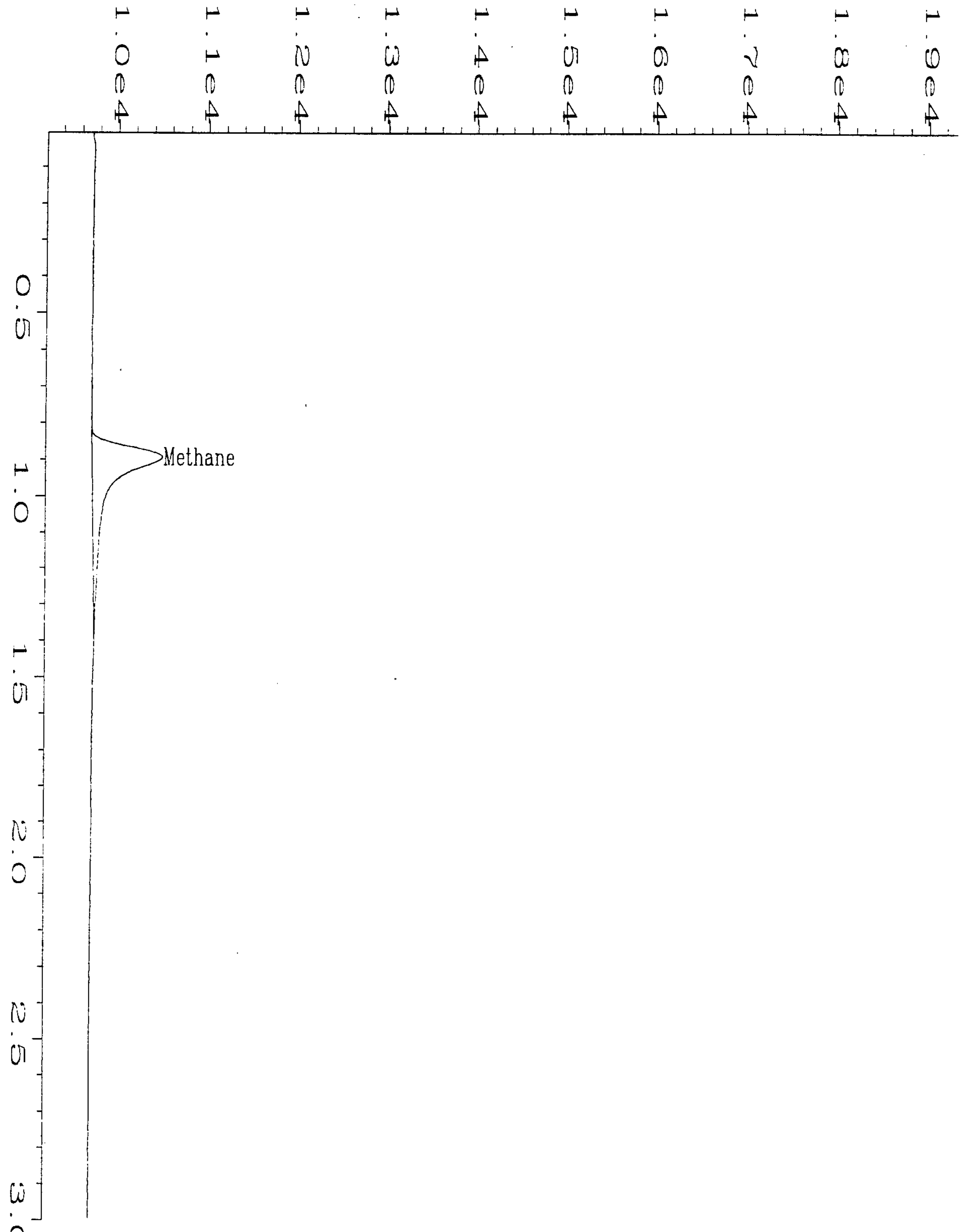
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0706.XLS




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : | C:\HPCHEM\ALCGAS\DATA\GAS0312\035R0101.D | | | |
| Operator | : | Bill Michener | Page Number | : | 1 |
| Instrument | : | ALCGAS | Vial Number | : | 35 |
| Sample Name | : | X20032Dup;1 | Injection Number | : | 1 |
| Time Bar Code | : | | Sequence Line | : | 1 |
| .. uired on | : | 13 Mar 96 10:58 AM | Instrument Method | : | METHANE.MTH |
| R t Created on | : | 13 Mar 96 11:21 AM | Analysis Method | : | GAS0313.MTH |
| L Recalib on | : | 13 MAR 96 08:33 AM | Sample Amount | : | 0 |
| Multiplier | : | 1 | ISTD Amount | : | |
| Sample Info | : | 96-0706;BE-MP17-01;Water | | | |

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP8-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X20033 | Lab Project No. | : 96-0706 |
| Date Sampled | : 3/11/96 | Dilution Factor | : 50.00 |
| Date Received | : 3/12/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312036 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 3.5 | 0.1 |

| | | |
|---|---|---|
| Temperature | : | 72.8 F |
| Amount Injected | : | 0.01 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 393.241 ug |
| Atomic weight(Methane) | : | 16 g |

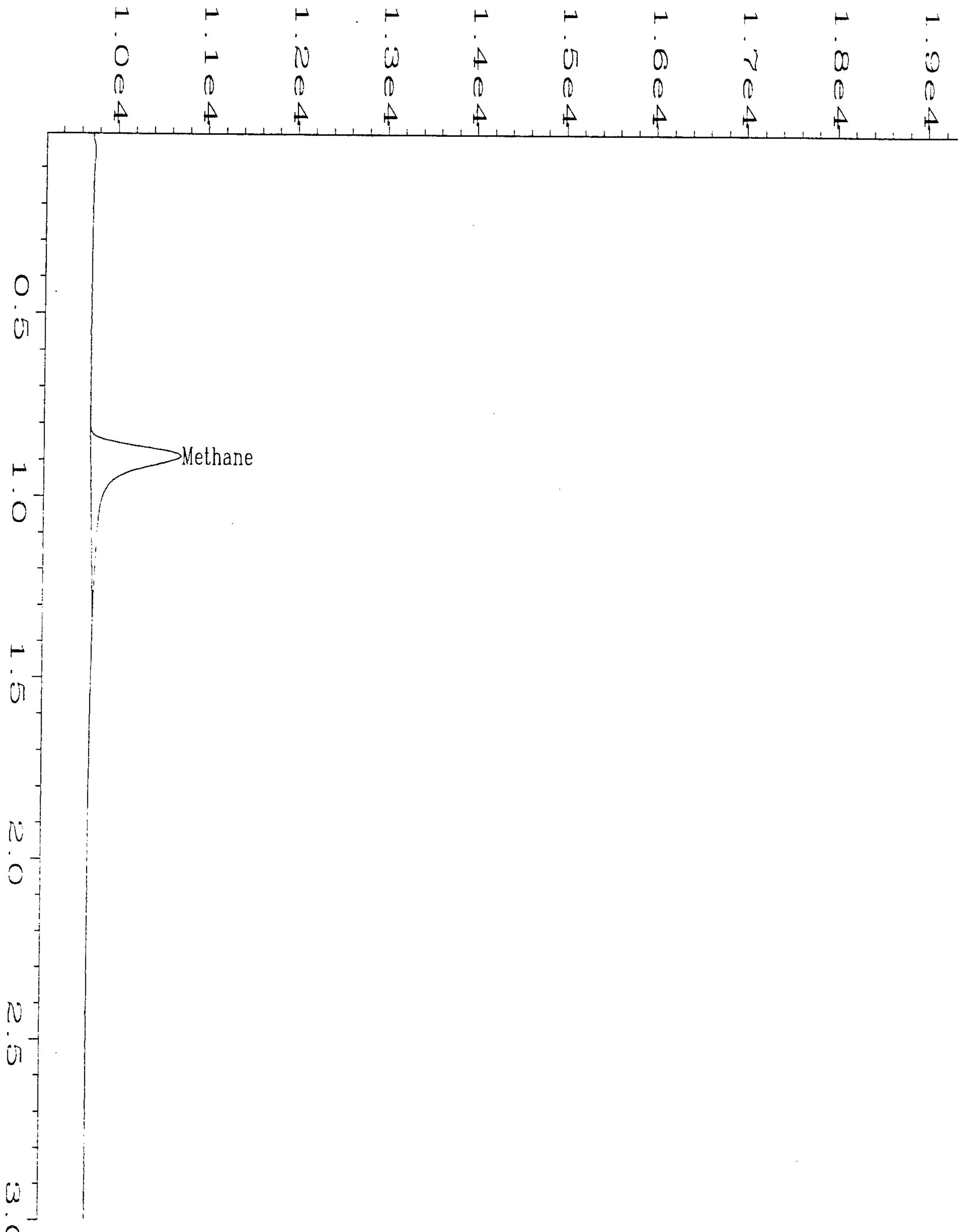
| | | |
|---|---|---|
| Saturation Concentration | Meth | 0.84551 |
| Concentration in Head Space | Meth | 2.66002 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0706.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\034R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X20032;1
Time Bar Code:
uired on : 13 Mar 96 10:54 AM
R t Created on: 13 Mar 96 11:21 AM
L Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1
Sample Info : 96-0706;BE-MP17-01;Water

Page Number : 1
Vial Number : 34
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

# Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP17-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X20032Dup | Lab Project No. | : 96-0706 |
| Date Sampled | : 3/11/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/12/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312035 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | | | |
|---|---|---|---|---|---|
| Temperature | : | 74.5 F | Saturation Concentration | Meth | 0.00013[illegible] |
| Amount Injected | : | 0.5 ml | | | |
| Total Volume of Sample | : | 43 ml | Concentration in Head Space | Meth | 0.00042[illegible] |
| Head space created | : | 4 ml | | | |
| Methane Area | : | 3.145 ug | | | |

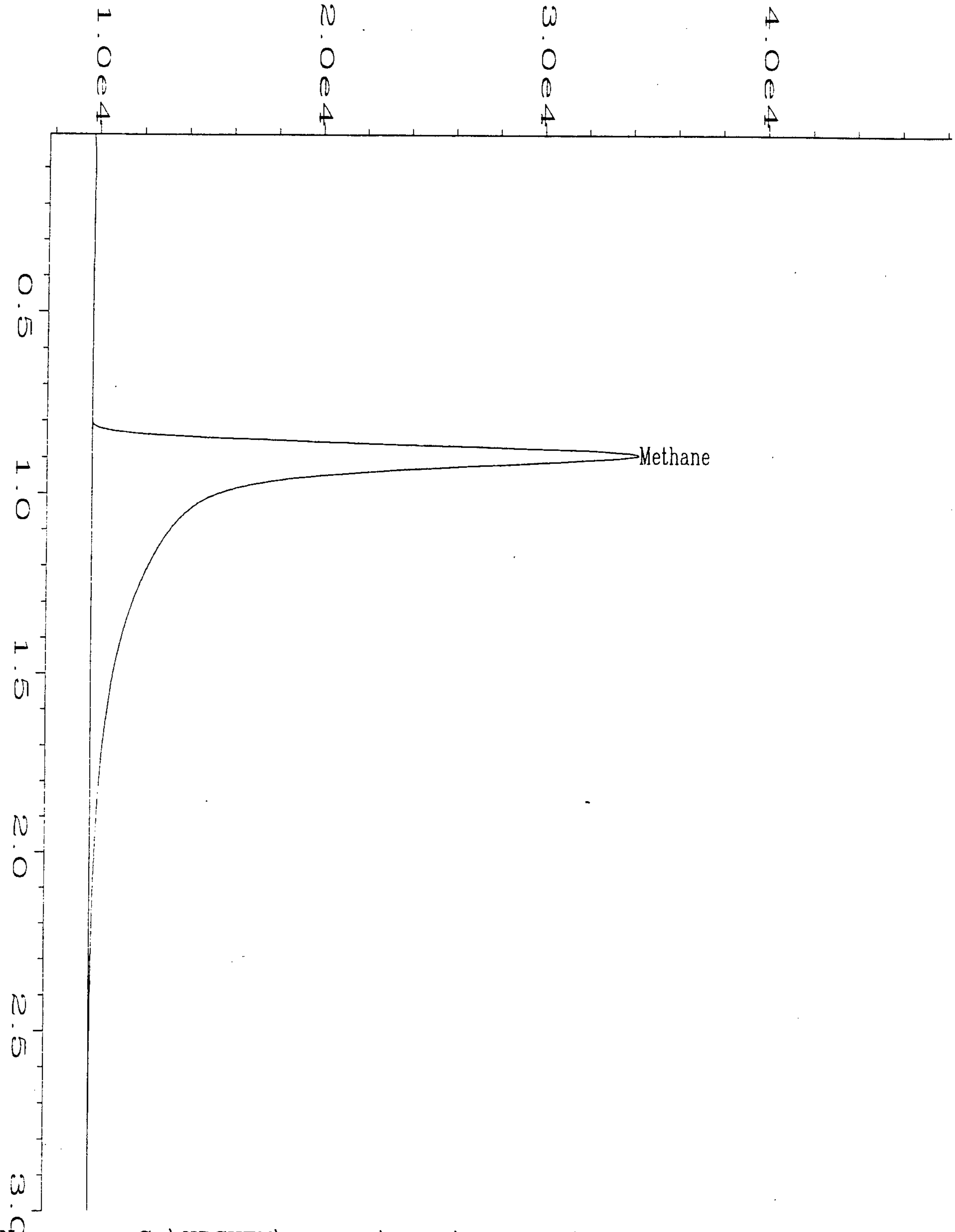
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0706.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\033R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X20031;1
Run Time Bar Code :
Acquired on : 13 Mar 96 10:11 AM
Report Created on : 13 Mar 96 11:21 AM
Last Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1
Sample Info : 96-0706;BE-MP15-01;Water

Page Number : 1
Vial Number : 33
Injection Number : 1
Sequence Line : 1
Instrument Method : METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP17-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X20032 | Lab Project No. | : 96-0706 |
| Date Sampled | : 3/11/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/12/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312034 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | |
|---|---|---|---|
| Temperature | : 74.3 F | Saturation Concentration Meth | 0.00014 |
| Amount Injected | : 0.5 ml | Concentration in Head Space Meth | 0.00045 |
| Total Volume of Sample | : 43 ml | | |
| Head space created | : 4 ml | | |
| Methane Area | : 3.365 ug | | |

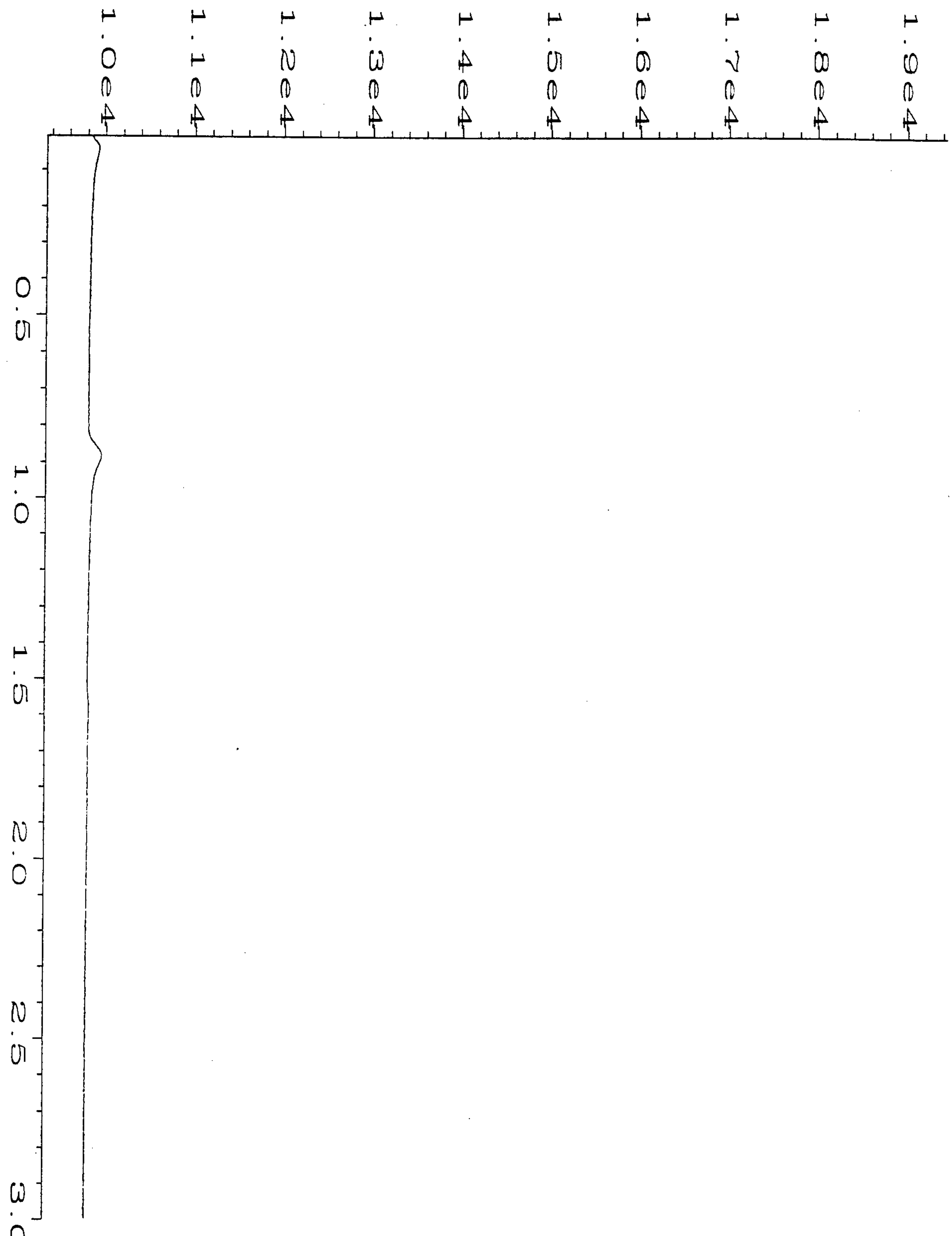
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0706.XLS




| | | | |
|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0312\022R0101.D | | |
| Operator | : Bill Michener | Page Number | : 1 |
| Instrument | : ALCGAS | Vial Number | : 22 |
| Sample Name | : GB031396 | Injection Number | : 1 |
| Time Bar Code: | | Sequence Line | : 1 |
| Acquired on | : 13 Mar 96 08:45 AM | Instrument Method | : METHANE.MTH |
| Report Created on | : 13 Mar 96 11:20 AM | Analysis Method | : GAS0313.MTH |
| Last Recalib on | : 13 MAR 96 08:33 AM | Sample Amount | : 0 |
| Multiplier | : 1 | ISTD Amount | : |
| Sample Info | : Gas Method Blank | | |

Displaced 4ml of deionized water in 43ml vial with Helium,
shook for 5 min. and injected 500ul

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP15-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X20031 | Lab Project No. | : 96-0706 |
| Date Sampled | : 3/11/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/12/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312033 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 0.023 | 0.002 |

| | | | | |
|---|---|---|---|---|
| Temperature | : 74.3 F | Saturation Concentration | Meth | 0.00548' |
| Amount Injected | : 0.5 ml | | | |
| Total Volume of Sample | : 43 ml | Concentration in Head Space | Meth | 0.01721 |
| Head space created | : 4 ml | | | |
| Methane Area | : 127.573 ug | | | |

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K Hoffman
Approved

AF0706.XLS

# EVERGREEN ANALYTICAL, Inc.

4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Total Organic Carbon

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/11/96 | Client Project ID. | : | 722450.14020 |
| Date Received | : | 3/12/96 | Lab Project Number | : | 96-0706 |
| Date Prepared | : | 3/14/96 | Method | : | EPA 415.1 |
| Date Analyzed | : | 3/14/96 | Detection Limit | : | 1.0 mg C/L |

| Evergreen Sample # | Client Sample ID. | Matrix | TOC mg C/L | Dilution Factor | |
|---|---|---|---|---|---|
| X20031 | BE-MP15-01 | Water | 6.6 | 1 | ← MP-7 |
| X20032 | BE-MP17-01 | Water | 1.5 | 1 | ← DUP MP-7 |
| X20033 | BE-MP-8-01 | Water | 102 | 1 | |
| X20034 | BE-MP-41-01 | Water | 103 | 1 | |
| Method Blank | (3/14/96) | | <1.0 | | |

### Quality Assurance

| | | Spike Amount (mgC/L) | Sample Result (mgC/L) | Spike Result (mgC/L) | % Recovery |
|---|---|---|---|---|---|
| X20031 | BE-MP15-01 Matrix Spike | 10.0 | 6.6 | 16.5 | 99 |
| X20031 | BE-MP15-01 Matrix Spike Dup | 10.0 | 6.6 | 17.0 | 104 |
| MS/MSD RPD | | | | | 4.8 |

Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

# Methane Report Form
## Method Blank Report

| | | | |
|---|---|---|---|
| Method Blank Number | : GB031396 | Client Project No. | : 722450.14020 |
| Date Extracted/Prepared | : 3/13/96 | Lab Project No. | : 96-0706 |
| Date Analyzed | : 3/13/96 | Dilution Factor | : 1.00 |
| | | Method | : RSKSOP-175 |
| | | Matrix | : Water |
| | | Lab File No. | : GAS0312022 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K Hollman
Approved

AF0706.XLS

# CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

**Evergreen Analytical Inc.**
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 1

COMPANY PARSONS ES
ADDRESS 1301 MARINA VILLAGE PKWY ST 200
CITY ALAMEDA STATE CA ZIP 94501
PHONE# 510 769 0100 FAX # 510 769 9244 FAX RESULTS Y / N

CLIENT CONTACT (print) MICHAEL PHELPS
PROJECT I.D. ~~II~~
EAL. QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Michael H. Friedman / Hilary Eichler
(print) Michael H. Friedman
HILARY EICHLER
Evergreen Analytical Cooler No. ______
Cooler Received ______

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL
Project # ______
Custodian ______

| CLIENT SAMPLE IDENTIFICATION | DATE SAMPLED | TIME | No. of Containers | MATRIX: Water-Drinking/Discharge/Ground (circle) | MATRIX: Soil / Solid | MATRIX: Oil / Sludge | TCLP VOA/BNA/Pest/Herb/Metals (circle) | VOA 8260/624/524.2 (circle) | ~~BNA 8270/625 (circle)~~ TOC | Pesticides 8080/608 (circle) | Pest/PCBs 8080/608/508 (circle) | Herbicides 8150/515 (circle) | PCB Screen | BTEX 8020/602 (circle)/MTBE (circle) | TRPH 418.1/Oil & Grease 413.1 (circle) | TVPH 8015mod. (Gasoline) | TEPH 8015mod. (Diesel) | Total Metals-DW / NPDES / SW846 (circle & list metals below) | Dissolved Metals - DW / SW846 (circle & list metals below) | ANIONS (NITRATE, NITRITE, CHLORIDE, SULFATE) | DISSOLVED AMMONIA | ALKALINITY | METHANE | | | | EAL Sample No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP15-01 | 3/11/96 | 1040 | 6 | X | | | | | X | | | | | | | | | | | X | X | | X | | | | |
| BE-MP17-01 | 3/11/96 | 1230 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | | |
| ~~BE-MP40-0~~ WE BE-MP-801 | 3/11/96 | 1515 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | | |
| BE-MP-41-01 | 3/11/96 | 15:20 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | | |

HT: ______ Location
DD: ______ Container Size

Instructions:

| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time | Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time |
|---|---|---|---|---|---|---|---|
| Hilary Eichler | 3/11/96 1400 | | | | | [signature] | 3/12/96 0930 |

**Evergreen Analytical Sample Receipt/Check-in Record**

Date & Time Rec'd: 3-12-96 0930 Shipped Via: FEX EX 1154092730
(Airbill # if applicable)

Client : PARSONS ES

Client Project ID(s): ______

EAL Project #(s): 96- ______ EAL Cooler(s): Y N

| | | | | | |
|---|---|---|---|---|---|
| Cooler# | 650 | | | | |
| Ice packs | Y N | Y N | Y N | Y N | Y N |
| Temperature °C | 8 | | | | |

| | Y | N | N/A |
|---|---|---|---|
| 1. Custody seal(s) present: | | ✓ | |
| Seals on cooler intact | | | ✓ |
| Seals on bottle intact | | | ✓ |
| 2. Chain of Custody present: | ✓ | | |
| 3. Samples Radioactive: (Comment on COC if >0.5mr/h) | | ✓ | |
| 4. Containers broken or leaking: (Comment on COC if Y) | | ✓ | |
| 5. Containers labeled: | ✓ | | |
| 6. COC agrees w/ bottles received: (Comment on COC if N) | ✓ | | |
| 7. COC agrees w/ labels: (Comment on COC if N) | ✓ | | |
| 8. Headspace in vials-waters only: (Comment on COC if Y) | | ✓ | |
| 9. VOA samples preserved: | ✓ | | |
| 10. pH measured on metals, cyanide or phenolics*: | | | ✓ |

List discrepancies ______

*Non-EAL provided containers only, water samples only.

| | Y | N |
|---|---|---|
| 11. Metal samples present: | | ✓ |
| Total ____ , Dissolved ____ , TCLP ____ | | |
| D or PD to be filtered: | | |
| T,TR,D,PD to be Preserved: | | |
| 12. Short holding times: | ✓ | |
| Specify parameters NO2, NO3 | | |
| 13. Multi-phase sample(s) present: | | ✓ |
| 14. COC signed w/ date/time: | ✓ | |

Comments: ______

(Additional comments on back)

Custodian Signature/Date: [signature] 3-12

# Evergreen Analytical Sample Log Sheet

**Project # 96-0706**

**Date(s) Sampled:** 03/11/96 COC

**Date Due:** 03/26/96

**ˉ\te Received:** 03/12/96 0930

**Holding Time(s):** 03/13-$NO_2$,$NO_3$,
3/25-ALKALINITY

**Client Project I.D.** 722450.14020

**Rush** STANDARD

**Client:** PARSONS ENGINEERING SCIENCE, INC.

**Cooler Return** N/A

**Address:** 1301 MARINA VILLAGE PKWY #200
ALAMEDA, CA 94501

**E.A. Cooler #** N/A

**Airbill #** FEDEX 1154092730

**Contact:** MICHAEL PHELPS

**Client P.O.**

**Phone #**510-769-0100 **Fax #**510-769-9244

**Special Invoicing/Billing**

**Special Instructions**

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X20031A | BE-MP15-01 | TOC | W | 125A | C4 |
| X20032A | BE-MP17-01 | TOC | W | 125A | C4 |
| X20033A | BE-MP-8-01 | TOC | W | 125A | C4 |
| X20034A | BE-MP-41-01 | TOC | W | 125A | C4 |
| )031B | BE-MP15-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X2 032B | BE-MP17-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X 33B | BE-MP-8-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X20034B | BE-MP-41-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X20031C | BE-MP15-01 | AMMONIA | W | 500P | C4 |
| X20032C | BE-MP17-01 | AMMONIA | W | 500P | C4 |
| X20033C | BE-MP-8-01 | AMMONIA | W | 500P | C4 |
| X20034C | BE-MP-41-01 | AMMONIA | W | 500P | C4 |
| X20032D | BE-MP17-01 | ALKALINITY | W | 125P | C4 |
| X20033D | BE-MP-8-01 | ALKALINITY | W | 125P | C4 |
| X20034D | BE-MP-41-01 | ALKALINITY | W | 125P | C4 |
| X20031D-F | BE-MP15-01 | METHANE | W | 40V | 2 |
| X20032E-G | BE-MP17-01 | METHANE | W | 40V | 2 |
| X20033E-G | BE-MP-8-01 | METHANE | W | 40V | 2 |
| X20034E-G | BE-MP-41-01 | METHANE | W | 40V | 2 |

R=Sample to be returned

Route GC/MS ___ GC X Metals ___ Wet Chem X HPLC ___ SxPrep ___

SxRec C QA/QC C Acctg C File Orig

Page 1 of 1 Page(s)

**Custodian/Date:** MyM 3/12/96
Am 3/13/96

# CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

**Evergreen Analytical Inc.**
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 1

COMPANY PARSONS ES
ADDRESS 1301 MARINA VILLAGE PKWY ST 200
CITY ALAMEDA STATE CA ZIP 94501
PHONE# 510 769 0100 FAX # 510 769 9244 FAX RESULTS Y / N

CLIENT CONTACT (print) MICHAEL PHELPS
PROJECT I.D. ~~II~~
EAL. QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Michael H Friedman Hilary Eichler
(print) Michael H. Friedman HILARY EICHLER
Evergreen Analytical Cooler No. ______
Cooler Received ______

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL Project # 96-006
Custodian JK

| CLIENT SAMPLE IDENTIFICATION | DATE SAMPLED | TIME | No. of Containers | MATRIX: Water-Drinking/Discharge/Ground (circle) | MATRIX: Soil / Solid | MATRIX: Oil / Sludge | TCLP VOA/BNA/Pest/Herb/Metals (circle) | VOA 8260/624/524.2 (circle) | ~~8240/8260/625 (circle)~~ TOC | Pesticides 8080/608 (circle) | Pest/PCBs 8080/608/508 (circle) | Herbicides 8150/515 (circle) | PCB Screen | BTEX 8020/602 (circle)/MTBE (circle) | TRPH 418.1/Oil & Grease 413.1 (circle) | TVPH 8015mod. (Gasoline) | TEPH 8015mod. (Diesel) | Total Metals-DW / NPDES / SW846 (circle & list metals below) | Dissolved Metals - DW / SW846 (circle & list metals below) | ANIONS (NITRATE N NITRITE, CHLORIDE, SULFATE) | DISSOLVED AMMONIA | ALKALINITY | METHANE | | | | EAL Sample No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP15-01 | 3/11/96 | 1040 | 6 | X | | | | X | | | | | | | | | | | | X | X | | X-D-F | | | | X20031 A |
| BE-MP17-01 | 3/11/96 | 1230 | 7 | X | | | | X | | | | | | | | | | | | X | X | X | X | | | | 032 |
| ~~BE-MP40-01~~ BE-MP-801 | 3/11/96 | 15:15 | 7 | X | | | | X | | | | | | | | | | | | X | X | X | K | | | | 033 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | ~~034~~ |
| BE-MP-41-01 | 3/11/96 | 15:20 | 7 | X | | | | X | | | | | | | | | | | | X | X | X | X | | | | 034 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HT: | | | | | | | | A | | | | | | | | | | | | B | C | D | E-G | | | | Location 2, C21 |
| DD: | | | | | | | | 125 A | | | | | | | | | | | | 125 P | 500 P | 125 P | 40 V | | | | Container Size |

Instructions:

| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time | Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time |
|---|---|---|---|---|---|---|---|
| M. H. Friedman | 3/11/96 | | | | | Mary M. | 3/7/96 |

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | |
|---|---|---|---|---|
| Date Sampled | : 3/7,8/96 | | Client Project ID. | : 722450. 14020 |
| Date Received | : 3/9/96 | | Lab Project Number | : 96-0686 |
| Date Prepared | : 3/9/96 | | Method | : EPA 300.0 |
| Date Analyzed | : 3/9/96 | | Detection Limit | : 0.056 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrate-N | | Dilution Factor |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 | Water | 2.6 | mg/L | 1 |
| X19944 | BE-MW02-01 | Water | 2.2 | mg/L | 1 |
| X19945 | BE-MP21-01 | Water | 1.8 | mg/L | 1 |
| X19946 | BE-MW01-01 | Water | 3.6 | mg/L | 1 |
| X19947 | BE-MW18-01 | Water | 2.3 | mg/L | 1 |
| X19948 | BE-MW19-01 | Water | 2.6 | mg/L | 1 |
| Method Blank | (3/9/96) | | <0.056 | mg/L | |

### Quality Assurance*

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 Matrix Spike | 10.0 | 11.5 | 21.8 | 102 |
| X19943 | BE-MP20-01 Matrix Spike Dup | 10.0 | 11.5 | 21.8 | 102 |
| MS/MSD RPD | | | | | 0.49 |

* Quality Assurance results reported as Nitrate ($NO_3$)

Analyst

Approved

## EVERGREEN ANALYTICAL, Inc.

4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

### Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : 3/7,8/96 | | Client Project ID. | : | 722450. 14020 |
| Date Received | : 3/9/96 | | Lab Project Number | : | 96-0686 |
| Date Prepared | : 3/9/96 | | Method | : | EPA 300.0 |
| Date Analyzed | : 3/9/96 | | Detection Limit | : | 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Sufate | | Dilution Factor |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 | Water | 11.6 | mg/L | 1 |
| X19944 | BE-MW02-01 | Water | 8.4 | mg/L | 1 |
| X19945 | BE-MP21-01 | Water | 9.3 | mg/L | 1 |
| X19946 | BE-MW01-01 | Water | 26.8 | mg/L | 1 |
| X19947 | BE-MW18-01 | Water | 7.0 | mg/L | 1 |
| X19948 | BE-MW19-01 | Water | 25.9 | mg/L | 1 |
| Method Blank | (3/9/96) | | <0.25 | mg/L | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 Matrix Spike | 10.0 | 11.6 | 21.8 | 102 |
| X19943 | BE-MP20-01 Matrix Spike Dup | 10.0 | 11.6 | 21.5 | 99 |
| MS/MSD RPD | | | | | 0.03 |

Analyst

Approved

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/7,8/96 | Client Project ID. | : | 722450. 14020 |
| Date Received | : | 3/9/96 | Lab Project Number | : | 96-0686 |
| Date Prepared | : | 3/9/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/9/96 | Detection Limit | : | 0.25mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Chloride | | Dilution Factor |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 | Water | 25.1 | mg/L | 1 |
| X19944 | BE-MW02-01 | Water | 13.5 | mg/L | 1 |
| X19945 | BE-MP21-01 | Water | 23.3 | mg/L | 1 |
| X19946 | BE-MW01-01 | Water | 74.6 | mg/L | 10 |
| X19947 | BE-MW18-01 | Water | 10.9 | mg/L | 1 |
| X19948 | BE-MW19-01 | Water | 103 | mg/L | 10 |
| Method Blank | (3/9/96) | | <0.25 | mg/L | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 Matrix Spike | 10.0 | 25.1 | 36.1 | 110 |
| X19943 | BE-MP20-01 Matrix Spike Dup | 10.0 | 25.1 | 34.9 | 98 |
| MS/MSD RPD | | | | | 11.4 |

Analyst

Approved

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(303) 425-6021

## Anion Report

| | | | | |
|---|---|---|---|---|
| Date Sampled | : 3/7,8/96 | Client Project ID. | : | 722450. 14020 |
| Date Received | : 3/9/96 | Lab Project Number | : | 96-0686 |
| Date Prepared | : 3/9/96 | Method | : | EPA 300.0 |
| Date Analyzed | : 3/9/96 | Detection Limit | : | 0.076 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrite-N | Dilution Factor |
|---|---|---|---|---|
| X19943 | BE-MP20-01 | Water | <0.076 mg/L | 1 |
| X19944 | BE-MW02-01 | Water | <0.076 mg/L | 1 |
| X19945 | BE-MP21-01 | Water | <0.076 mg/L | 1 |
| X19946 | BE-MW01-01 | Water | <0.076 mg/L | 1 |
| X19947 | BE-MW18-01 | Water | <0.076 mg/L | 1 |
| X19948 | BE-MW19-01 | Water | <0.076 mg/L | 1 |
| Method Blank | (3/9/96) | | <0.076 mg/L | |

### Quality Assurance*

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 Matrix Spike | 10.0 | <0.25 | 10.0 | 100 |
| X19943 | BE-MP20-01 Matrix Spike Dup | 10.0 | <0.25 | 10.0 | 100 |
| MS/MSD RPD | | | | | 0.10 |

*Quality Assurance results reported as Nitrite ($NO_2$)

Analyst

Approved

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(303) 425-6021

## Analysis Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/7,8/96 | Client Project ID. | : 722450.14020 |
| Date Received | : 3/9/96 | Lab Project Number | : 96-0686 |
| Date Prepared | : 3/11/96 | Method | : EPA 310.1 |
| Date Analyzed | : 3/11/96 | Detection Limit | : 5.0 $mgCaCO_3/L$ |

| Evergreen Sample # | Client Sample ID. | Matrix | Total Alkalinity ($mgCaCO_3/L$) | Dilution Factor |
|---|---|---|---|---|
| X19943 | BE-MP20-01 | Water | 84.6 | 1 |
| X19944 | BE-MW02-01 | Water | 86.4 | 1 |
| X19945 | BE-MP21-01 | Water | 76.8 | 1 |
| X19946 | BE-MW01-01 | Water | 177 | 1 |
| X19947 | BE-MW18-01 | Water | 67.6 | 1 |
| X19948 | BE-MW19-01 | Water | 91.9 | 1 |
| Method Blank | (3/11/96) | | <5.0 | |

### Quality Assurance

| Reference | True Value ($mgCaCO_3/L$) | Result ($mgCaCO_3/L$) | % Recovery |
|---|---|---|---|
| ERA Alkalinity Lot# 0814-95-0 | 120 | 116 | 97 |

Analyst

Approved

# EVERGREEN ANALYTICAL, Inc.

4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Analysis Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/7,8/96 | Client Project ID. | : 722450.14020 |
| Date Received | : 3/9/96 | Lab Project Number | : 96-0686 |
| Date Prepared | : 3/11/96 | Method | : Standard Method 4500 $NH_3$ F |
| Date Analyzed | : 3/11/96 | Detection Limit | : 0.80 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Ammonia-N | Dilution Factor |
|---|---|---|---|---|
| X19943 | BE-MP20-01 | Water | <0.80 mg/L | 1 |
| X19944 | BE-MW02-01 | Water | <0.80 mg/L | 1 |
| X19945 | BE-MP21-01 | Water | <0.80 mg/L | 1 |
| X19946 | BE-MW01-01 | Water | <0.80 mg/L | 1 |
| X19947 | BE-MW18-01 | Water | <0.80 mg/L | 1 |
| X19948 | BE-MW19-01 | Water | <0.80 mg/L | 1 |
| Method Blank | (3/11/96) | | <0.80 mg/L | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 Matrix Spike | 10.0 | <0.80 | 9.1 | 91 |
| X19943 | BE-MP20-01 Matrix Spike Dup | 10.0 | <0.80 | 9.1 | 91 |
| MS/MSD RPD | | | | | 0.44 |

Analyst

Approved

Evergreen Analytical, Inc.
4036 Youngfield, Wheat Ridge, CO 80033
(303) 425-6021

# RSK-175 Gas Method
## Methane LCS Report Form

| | | | |
|---|---|---|---|
| LCS No. | : LCS031396 | EPA Method No. | : RSKSOP-175 |
| Date Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Method Blank | : GB031396 |
| E.A. LCS Source No. | : 1723 | Lab File No. | : GAS0312038 |

| Compound | Spike Added (ug) | Method Blank Concentration (ug) | LCS Concentration (ug) | LCS %REC | QC Limits %REC |
|---|---|---|---|---|---|
| Methane Gas | 500 | 0 | 361 | 72 | 67-85 |

Spike Recovery: 0 out of (1) outside limits.

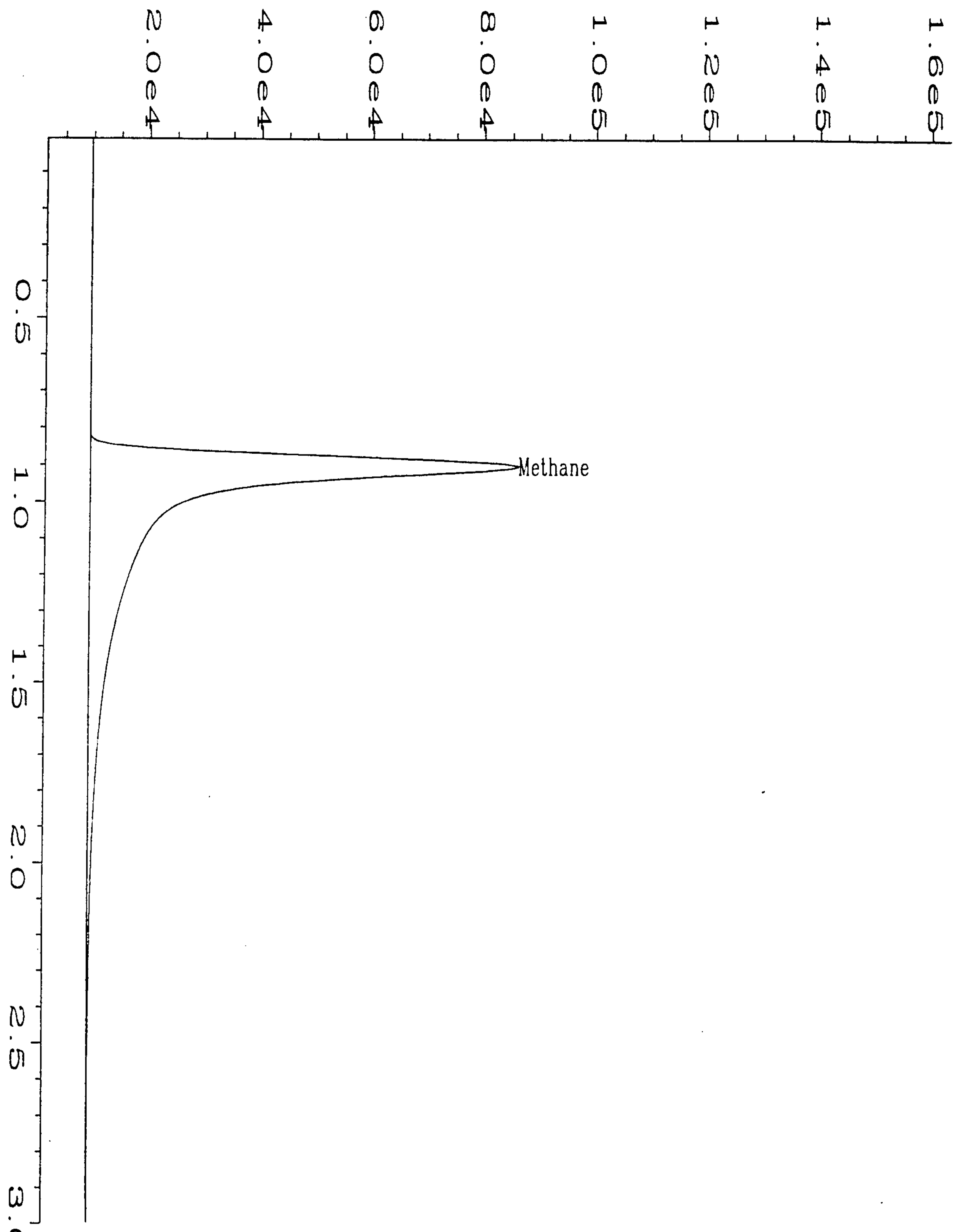
Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

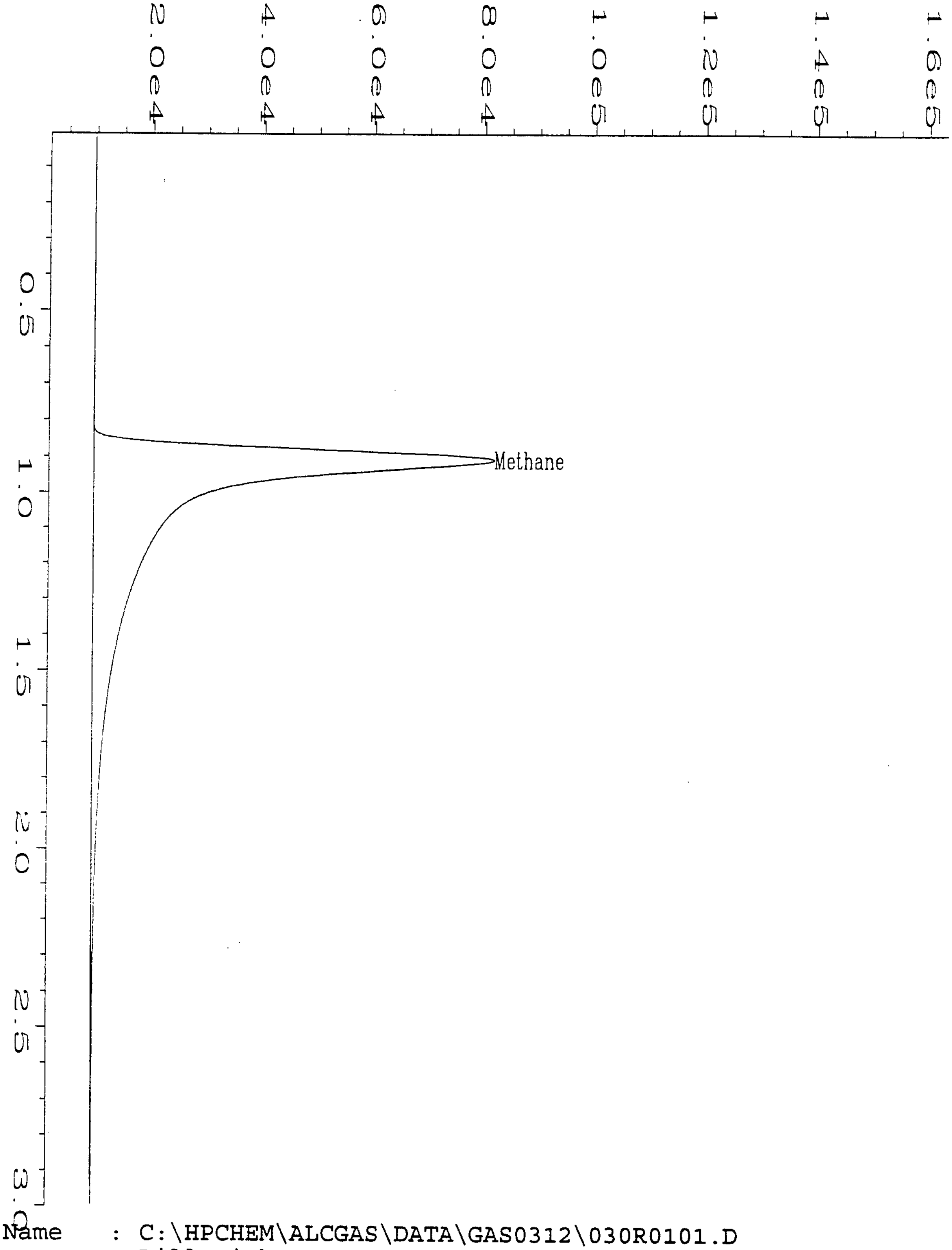
K. Hollman
Approved

LCS0313.XLS; 3/13/96




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\038R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : LCS031396;Gas
Run Time Bar Code:
Acquired on : 13 Mar 96 11:23 AM
Report Created on: 13 Mar 96 11:26 AM
Last Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1

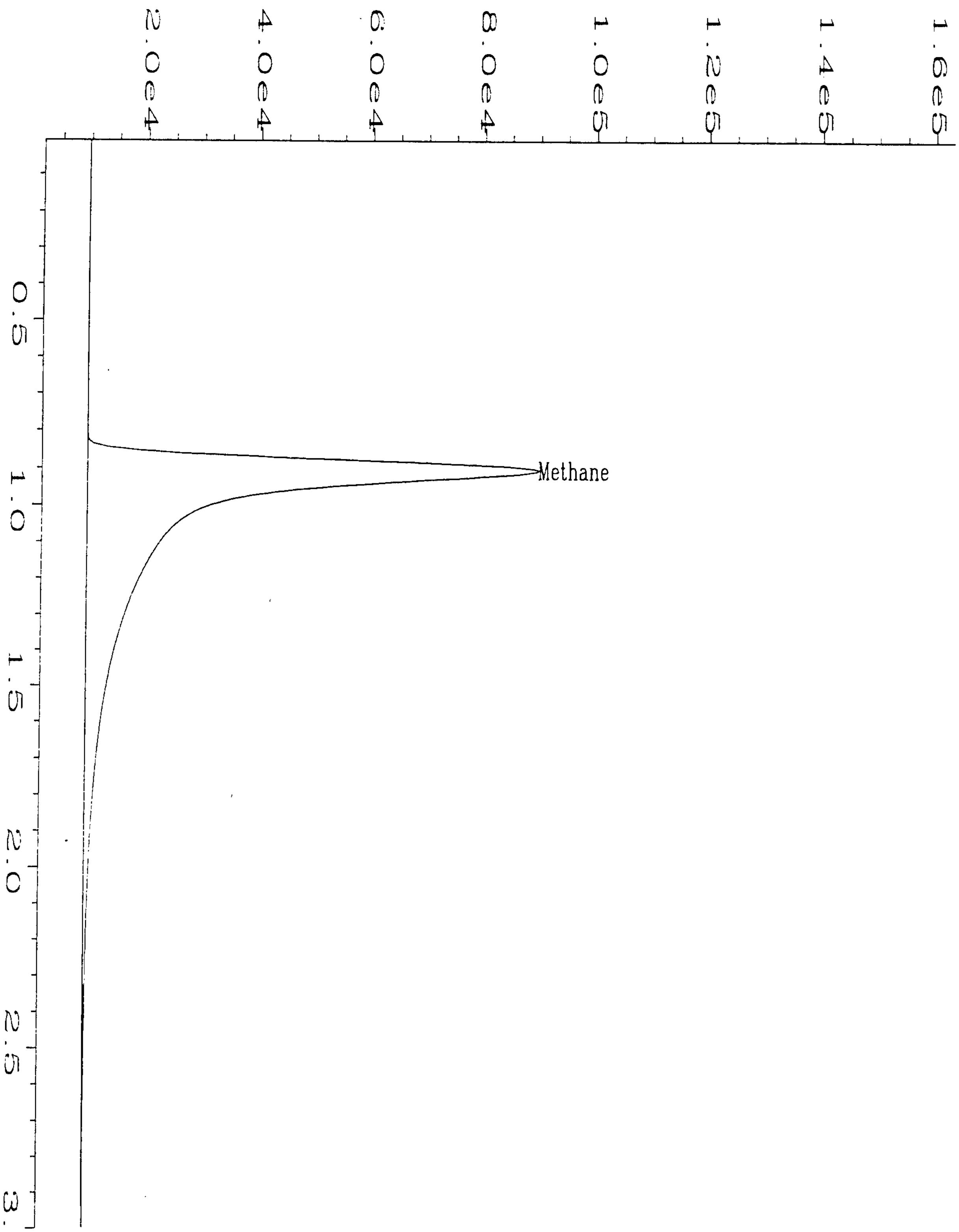
Page Number : 1
Vial Number : 38
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MT
Analysis Method : GAS0313.MT
Sample Amount : 0
ISTD Amount :




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\030R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19943MS;1
Time Bar Code:
[illegible]uired on : 13 Mar 96 09:38 AM
Re[illegible]t Created on: 13 Mar 96 11:20 AM
L[illegible]Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1

Page Number : 1
Vial Number : 30
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

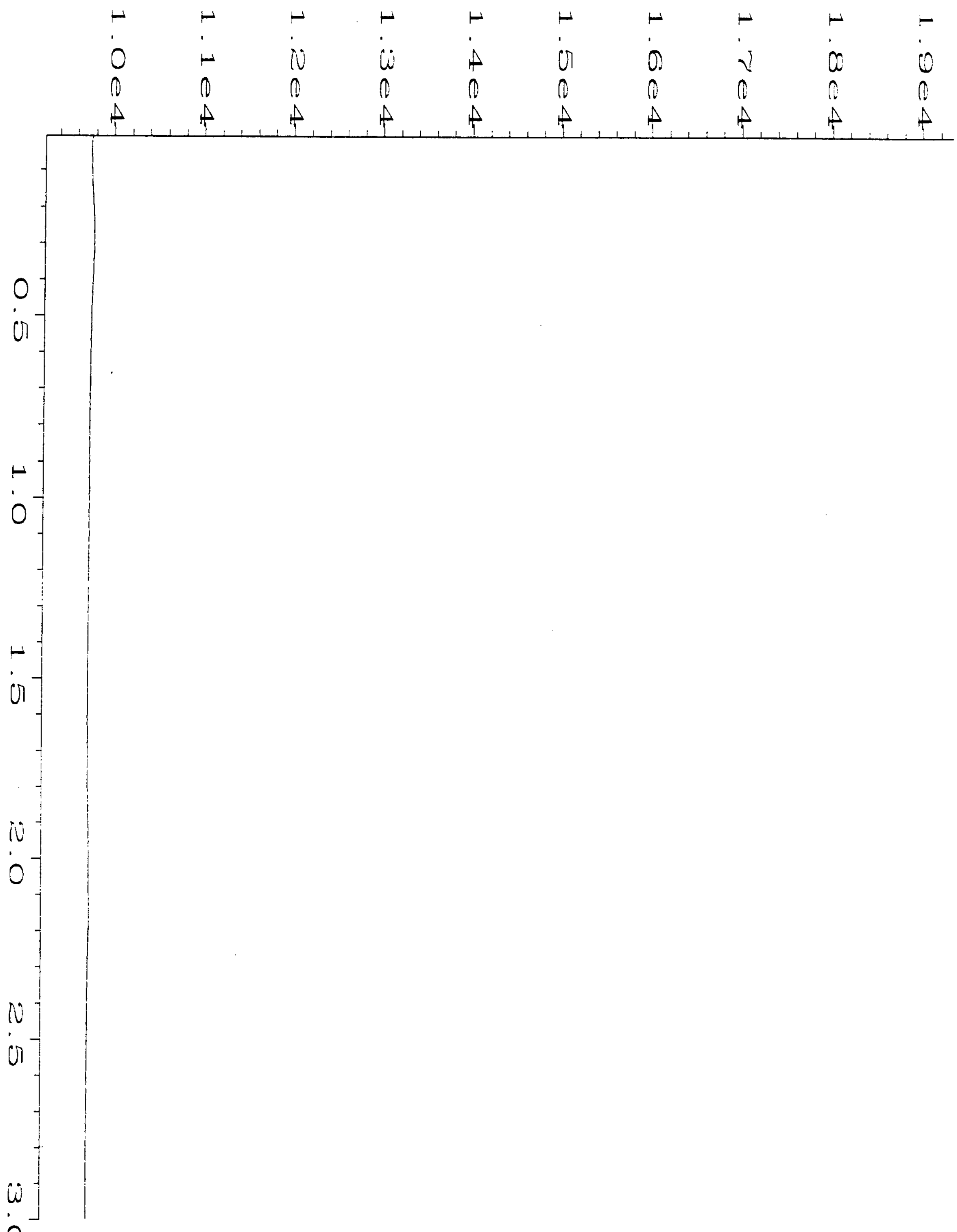
Sample Info : 96-0686;BE-MP20-01;Displaced 4ml with 1% methane gas(#1723), shook for 5 min. and injected 50ul to equal a theoretical spike of 500ug. The sample is injected at a




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\031R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19943MSD;1
Run Time Bar Code:
Acquired on : 13 Mar 96 09:45 AM
Report Created on: 13 Mar 96 11:20 AM
Last Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1

Page Number : 1
Vial Number : 31
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.M
Analysis Method : GAS0313.M
Sample Amount : 0
ISTD Amount :

Sample Info : 96-0686;BE-MP20-01;Displaced 4ml with 1% methane gas(#1723), shook for 5 min. and injected 50ul to equal a theoretical spike of 500ug. The sample is injected at a




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : | C:\HPCHEM\ALCGAS\DATA\GAS0312\029R0101.D | | | |
| Operator | : | Bill Michener | Page Number | : | 1 |
| Instrument | : | ALCGAS | Vial Number | : | 29 |
| Sample Name | : | X19948Dup;1 | Injection Number | : | 1 |
| Time Bar Code | : | | Sequence Line | : | 1 |
| uired on | : | 13 Mar 96 09:27 AM | Instrument Method | : | METHANE.MTH |
| R t Created on | : | 13 Mar 96 11:20 AM | Analysis Method | : | GAS0313.MTH |
| L Recalib on | : | 13 MAR 96 08:33 AM | Sample Amount | : | 0 |
| Multiplier | : | 1 | ISTD Amount | : | |
| Sample Info | : | 96-0686;BE-MW19-01;Water | | | |

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(303) 425-6021

# RSK-175 Gas Method
## Methane, Ethane, Ethene Gas Matrix Spike / Matrix Spike Duplicate Report

| | | | |
|---|---|---|---|
| Client Sample No. | : BE-MP20-01 | Client Project No. | : 722450.14020 |
| Lab Sample No. | : X19943 | Lab Project No. | : 96-0686 |
| Date Sampled | : 3/8/96 | EPA Method No. | : RSKSOP-175 |
| Date Received | : 3/9/96 | Matrix | : Water |
| Date Prepared | : 3/13/96 | Method Blank | : GB031396 |
| Date Analyzed | : 3/13/96 | Lab File No's. | : GAS0312030,031 |
| E.A. MS/MSD Spike Source No. | : 1723 | | |

| Compound | Spike Added (ug) | Sample Concentration (ug) | MS Concentration (ug) | MS %REC | QC Limits %REC |
|---|---|---|---|---|---|
| Methane Gas | 500 | 0 | 391 | 78 | 40-89 |

| Compound | Spike Added (ug) | MSD Concentration (ug) | MSD %REC | RPD | QC Limits RPD | QC Limits %REC |
|---|---|---|---|---|---|---|
| Methane Gas | 500 | 428 | 86 | 9.0 | 0-24.4 | 40-89 |

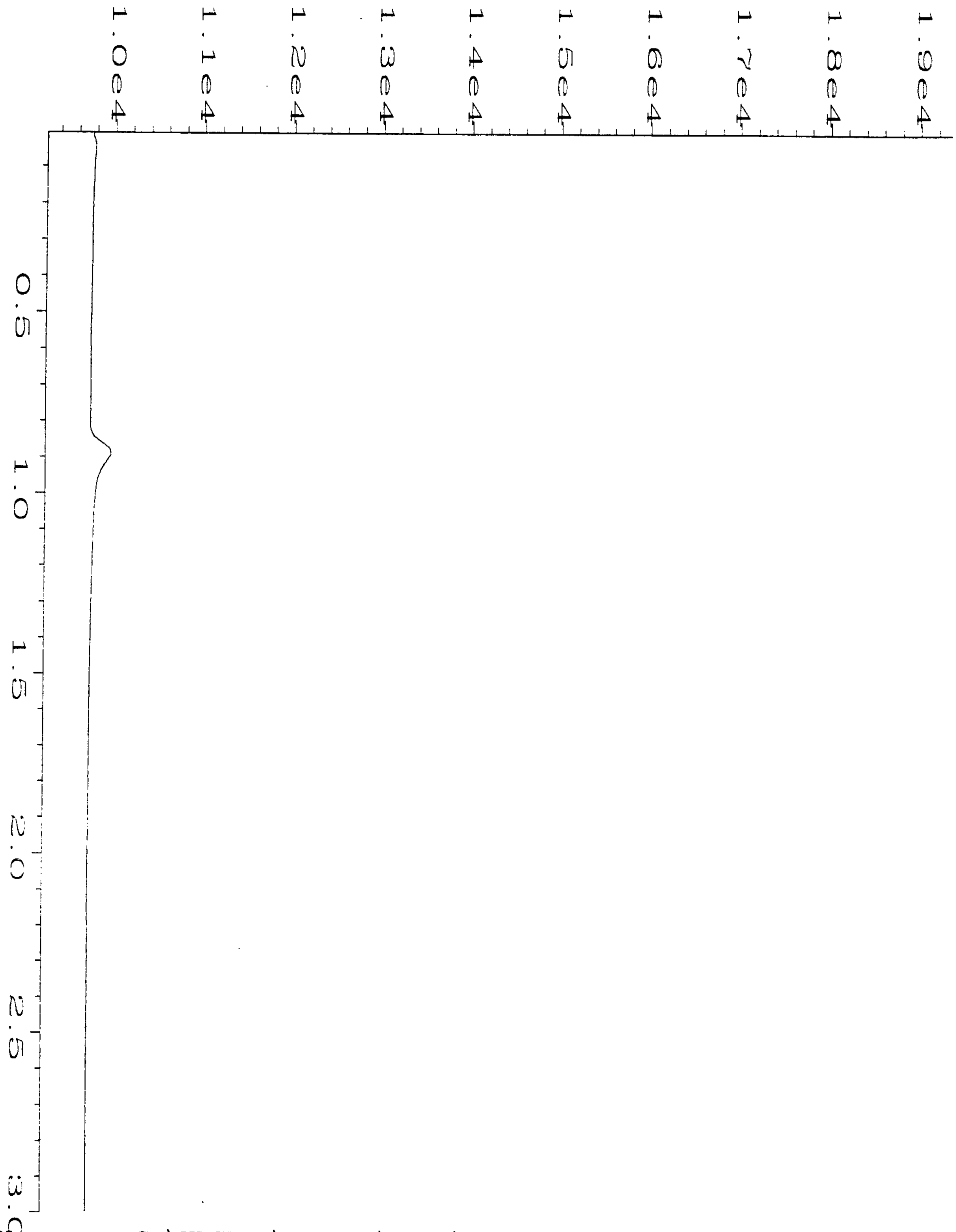
RPD: 0 out of (1) outside limits.
Spike Recovery: 0 out of (2) outside limits.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available

Note: The Spike was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

Analyst

K. Hollman
Approved




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\028R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19948;1
Time Bar Code:
uired on : 13 Mar 96 09:23 AM
Re Created on: 13 Mar 96 11:20 AM
La ecalib on : 13 MAR 96 08:33 AM
Multiplier : 1
Sample Info : 96-0686;BE-MW19-01;Water

Page Number : 1
Vial Number : 28
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

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(303) 425-6021

# Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MW19-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X19948Dup | Lab Project No. | : 96-0686 |
| Date Sampled | : 3/7/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/9/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312029 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | |
|---|---|---|
| Temperature | : | 69.6 F |
| Amount Injected | : | 0.5 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 0 ug |

| | | |
|---|---|---|
| Saturation Concentration | Meth | |
| Concentration in Head Space | Meth | |

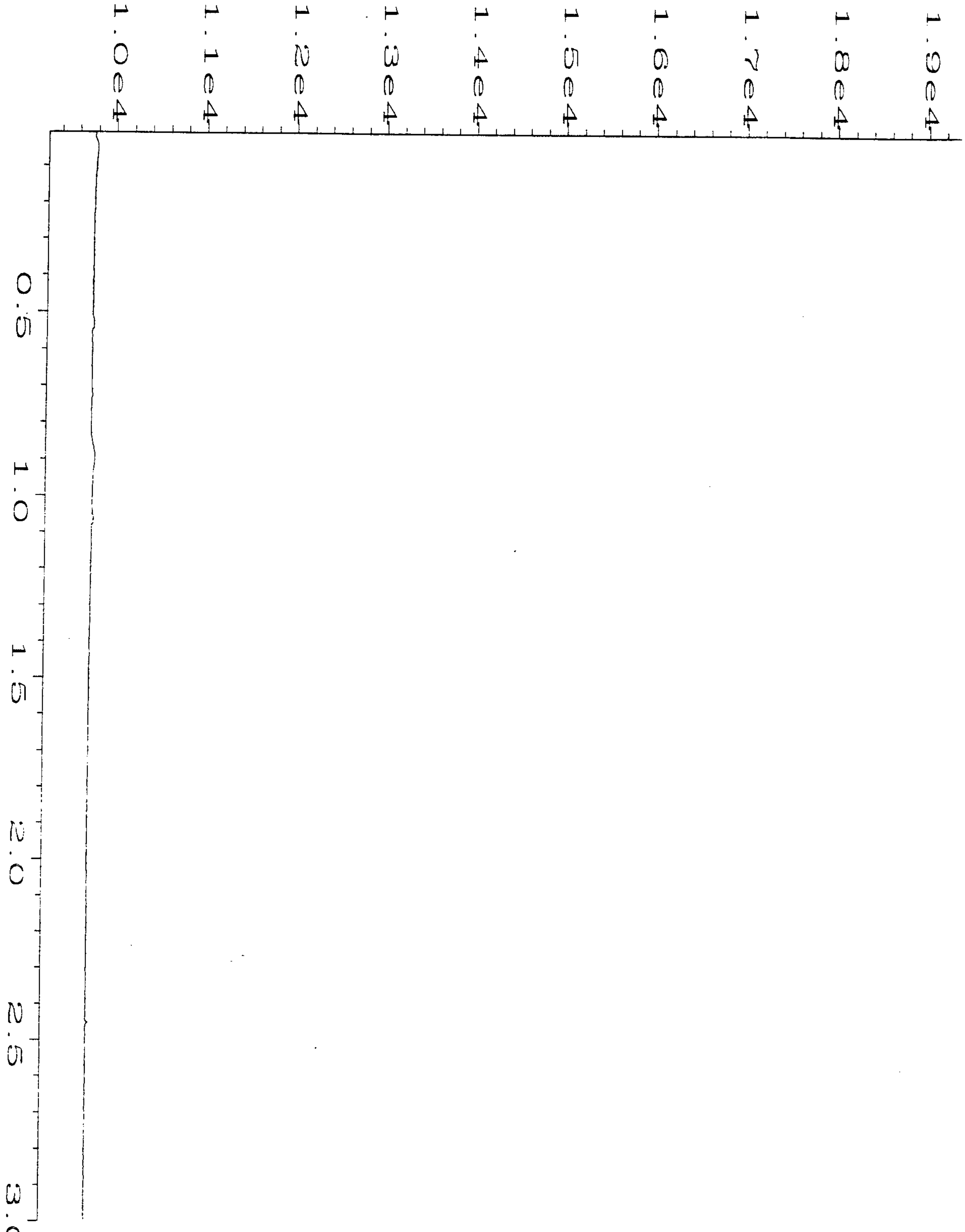
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA =Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0686.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\027R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19947;1
Time Bar Code:
uired on : 13 Mar 96 09:19 AM
Re Created on: 13 Mar 96 11:20 AM
La ecalib on : 13 MAR 96 08:33 AM
Multiplier : 1
Sample Info : 96-0686;BE-MW18-01;Water

Page Number : 1
Vial Number : 27
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
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## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MW19-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X19948 | Lab Project No. | : 96-0686 |
| Date Sampled | : 3/7/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/9/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312028 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | | |
|---|---|---|---|---|
| Temperature | : 69.7 F | Saturation Concentration | Meth | |
| Amount Injected | : 0.5 ml | | | |
| Total Volume of Sample | : 43 ml | Concentration in Head Space | Meth | |
| Head space created | : 4 ml | | | |
| Methane Area | : 0 ug | | | |

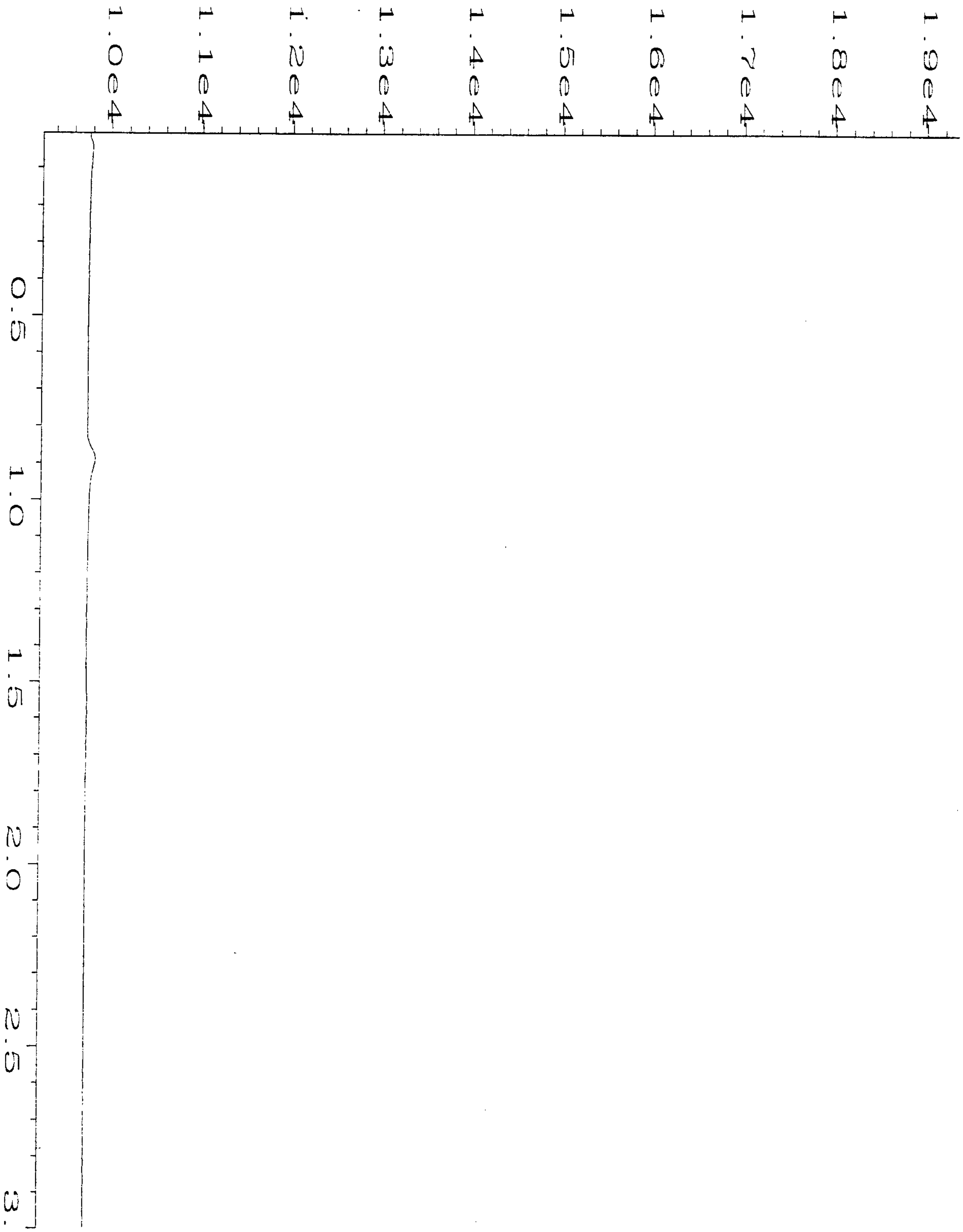
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hallman
Approved

AF0686.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\026R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19946;1
Time Bar Code:
Acquired on : 13 Mar 96 09:16 AM
Report Created on: 13 Mar 96 11:20 AM
Last Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1
Sample Info : 96-0686;BE-MW01-01;Water

Page Number : 1
Vial Number : 26
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

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## Methane Report Form

| | | | | | |
|---|---|---|---|---|---|
| Client Sample Number | : | BE-MW18-01 | Client Project No. | : | 722450.14020 |
| Lab Sample Number | : | X19947 | Lab Project No. | : | 96-0686 |
| Date Sampled | : | 3/7/96 | Dilution Factor | : | 1.00 |
| Date Received | : | 3/9/96 | Method | : | RSKSOP-175 |
| Date Extracted/Prepared | : | 3/13/96 | Matrix | : | Water |
| Date Analyzed | : | 3/13/96 | Lab File No. | : | GAS0312027 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | |
|---|---|---|---|
| Temperature | : | 66.7 | F |
| Amount Injected | : | 0.5 | ml |
| Total Volume of Sample | : | 43 | ml |
| Head space created | : | 4 | ml |
| Methane Area | : | 0 | ug |

Saturation Concentration Meth ____

Concentration in Head Space Meth ____

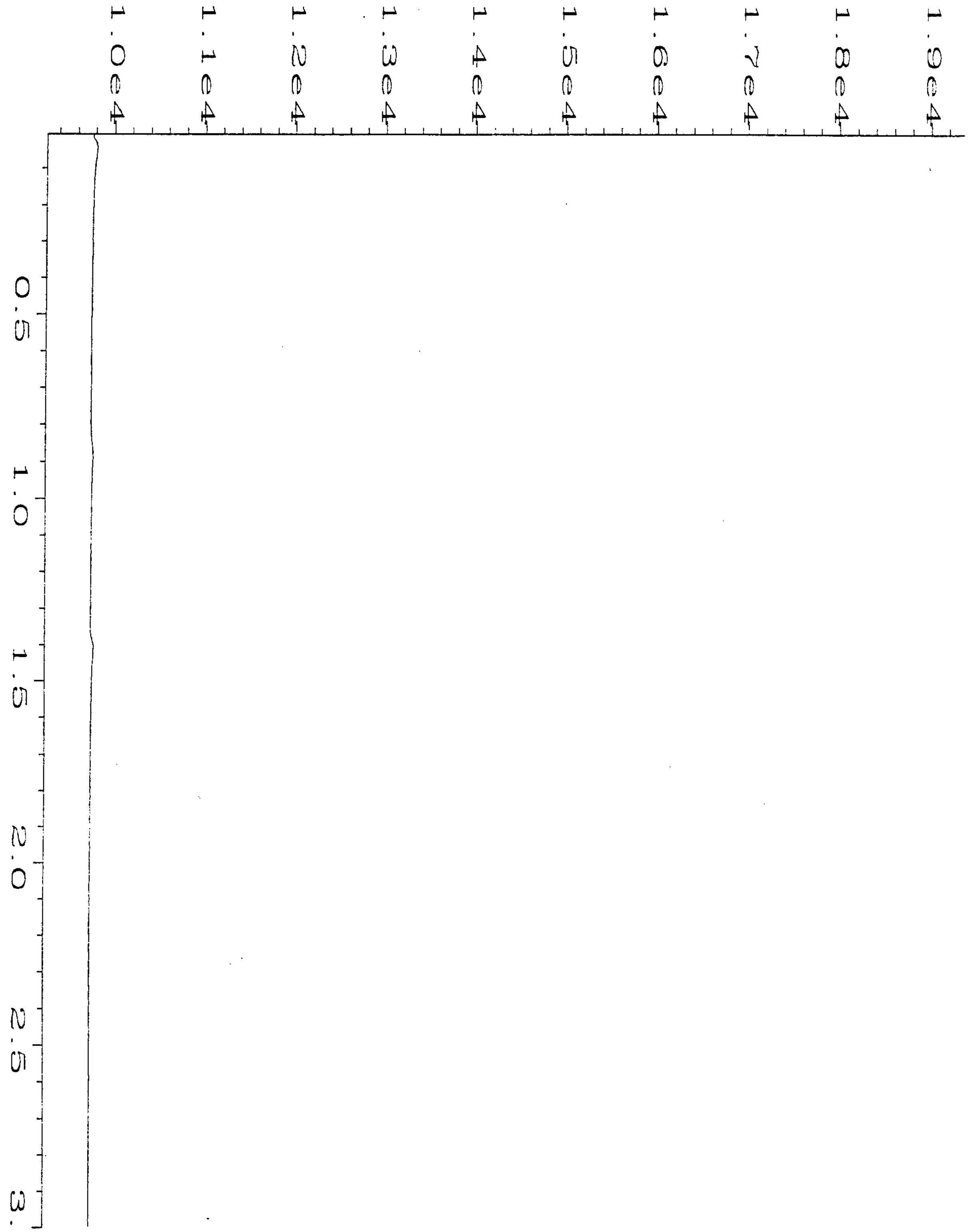
| | | | |
|---|---|---|---|
| Atomic weight(Methane) | : | 16 | g |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0686.XLS




| | | | |
|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0312\025R0101.D | | |
| Operator | : Bill Michener | Page Number | : 1 |
| Instrument | : ALCGAS | Vial Number | : 25 |
| Sample Name | : X19945;1 | Injection Number | : 1 |
| Time Bar Code | : | Sequence Line | : 1 |
| Acquired on | : 13 Mar 96 09:12 AM | Instrument Method | : METHANE.MTH |
| Report Created on | : 13 Mar 96 11:20 AM | Analysis Method | : GAS0313.MTH |
| Last Recalib on | : 13 MAR 96 08:33 AM | Sample Amount | : 0 |
| Multiplier | : 1 | ISTD Amount | : |
| Sample Info | : 96-0686;BE-MP21-01;Water | | |

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# Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MW01-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X19946 | Lab Project No. | : 96-0686 |
| Date Sampled | : 3/8/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/9/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312026 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | | |
|---|---|---|---|---|
| Temperature | : 66.6 F | Saturation Concentration | Meth | |
| Amount Injected | : 0.5 ml | | | |
| Total Volume of Sample | : 43 ml | Concentration in Head Space | Meth | |
| Head space created | : 4 ml | | | |
| Methane Area | : 0 ug | | | |

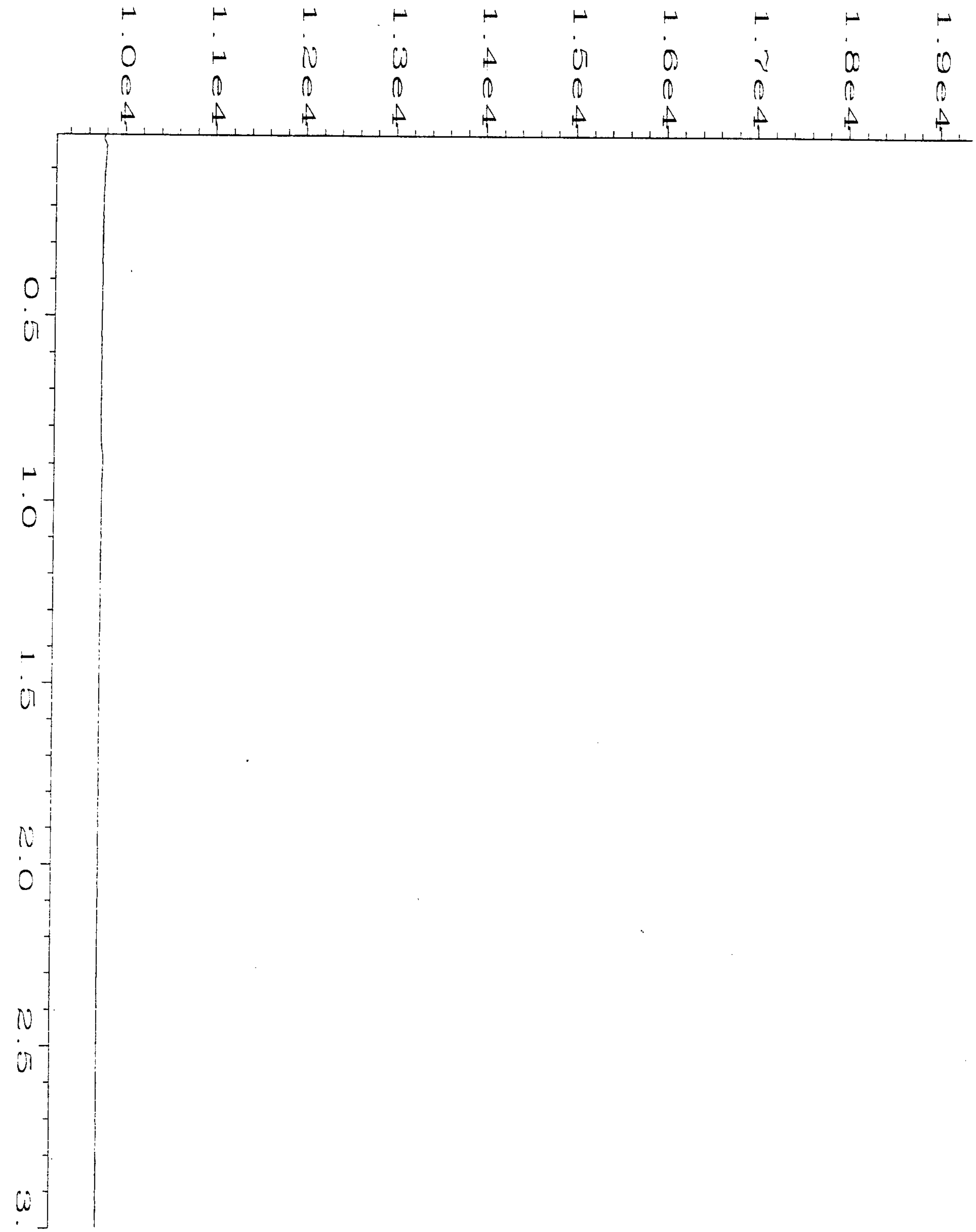
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0686.XLS




| | | | |
|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0312\024R0101.D | | |
| Operator | : Bill Michener | Page Number | : 1 |
| Instrument | : ALCGAS | Vial Number | : 24 |
| Sample Name | : X19944;1 | Injection Number | : 1 |
| P Time Bar Code: | | Sequence Line | : 1 |
| ired on | : 13 Mar 96 09:08 AM | Instrument Method | : METHANE.MTH |
| Rep t Created on | : 13 Mar 96 11:20 AM | Analysis Method | : GAS0313.MTH |
| Las ecalib on | : 13 MAR 96 08:33 AM | Sample Amount | : 0 |
| Mul plier | : 1 | ISTD Amount | : |
| Sample Info | : 96-0686;BE-MW02-01;Water | | |

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

# Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP21-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X19945 | Lab Project No. | : 96-0686 |
| Date Sampled | : 3/8/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/9/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312025 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | |
|---|---|---|
| Temperature | : | 65.3 F |
| Amount Injected | : | 0.5 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 0 ug |

| | | |
|---|---|---|
| Saturation Concentration | Meth | |
| Concentration in Head Space | Meth | |

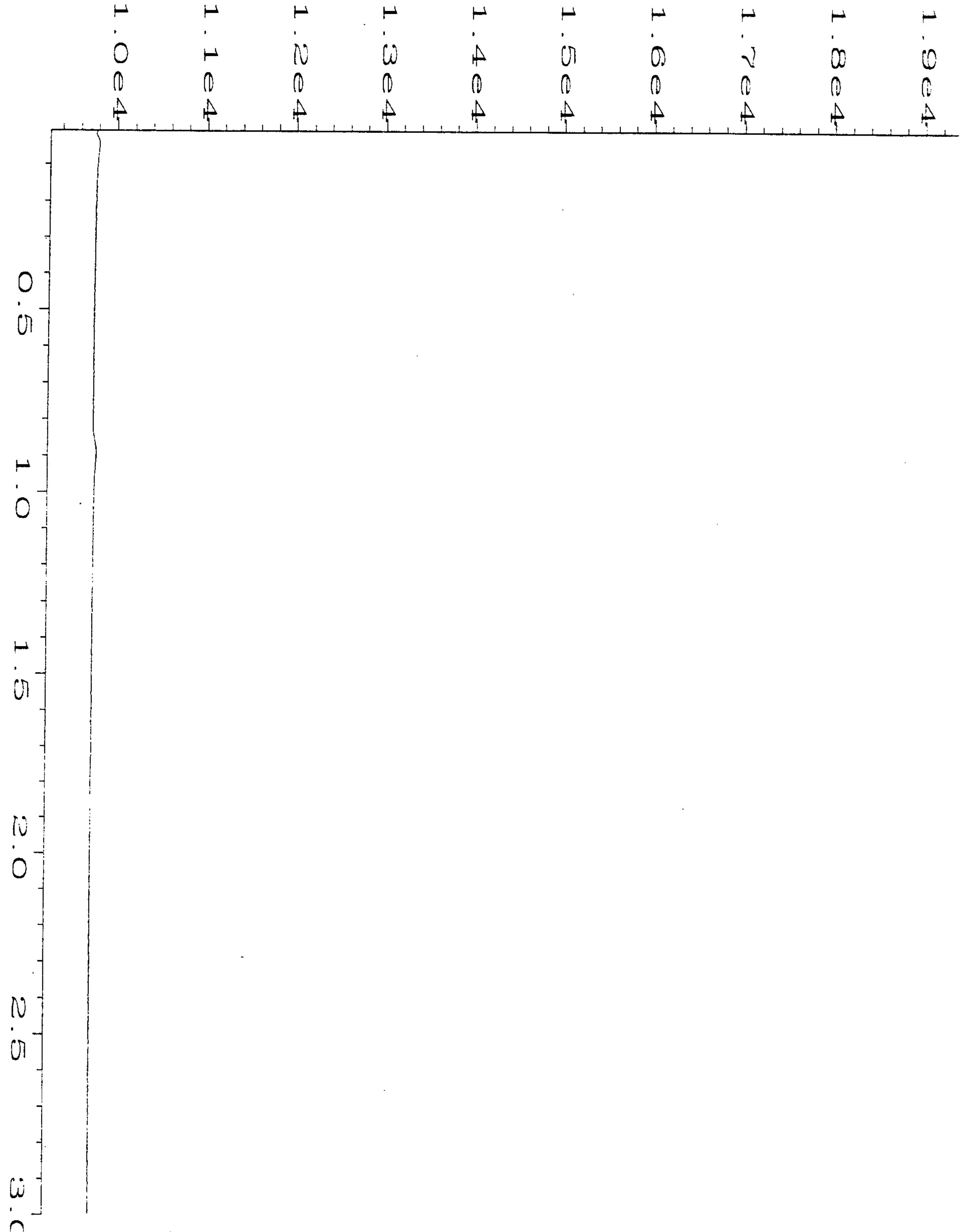
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0686.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\023R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19943;1
R` Time Bar Code:
.uired on : 13 Mar 96 09:04 AM
Report Created on: 13 Mar 96 11:20 AM
La Recalib on : 13 MAR 96 08:33 AM
Multiplier : 1
Sample Info : 96-0686;BE-MP20-01;Water

Page Number : 1
Vial Number : 23
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0313.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MW02-01 | Client Project No. | : 722450.14020 |
| Lab Sample Number | : X19944 | Lab Project No. | : 96-0686 |
| Date Sampled | : 3/8/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/9/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/13/96 | Matrix | : Water |
| Date Analyzed | : 3/13/96 | Lab File No. | : GAS0312024 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | |
|---|---|---|
| Temperature | : | 67.4 F |
| Amount Injected | : | 0.5 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 0 ug |
| Atomic weight(Methane) | : | 16 g |

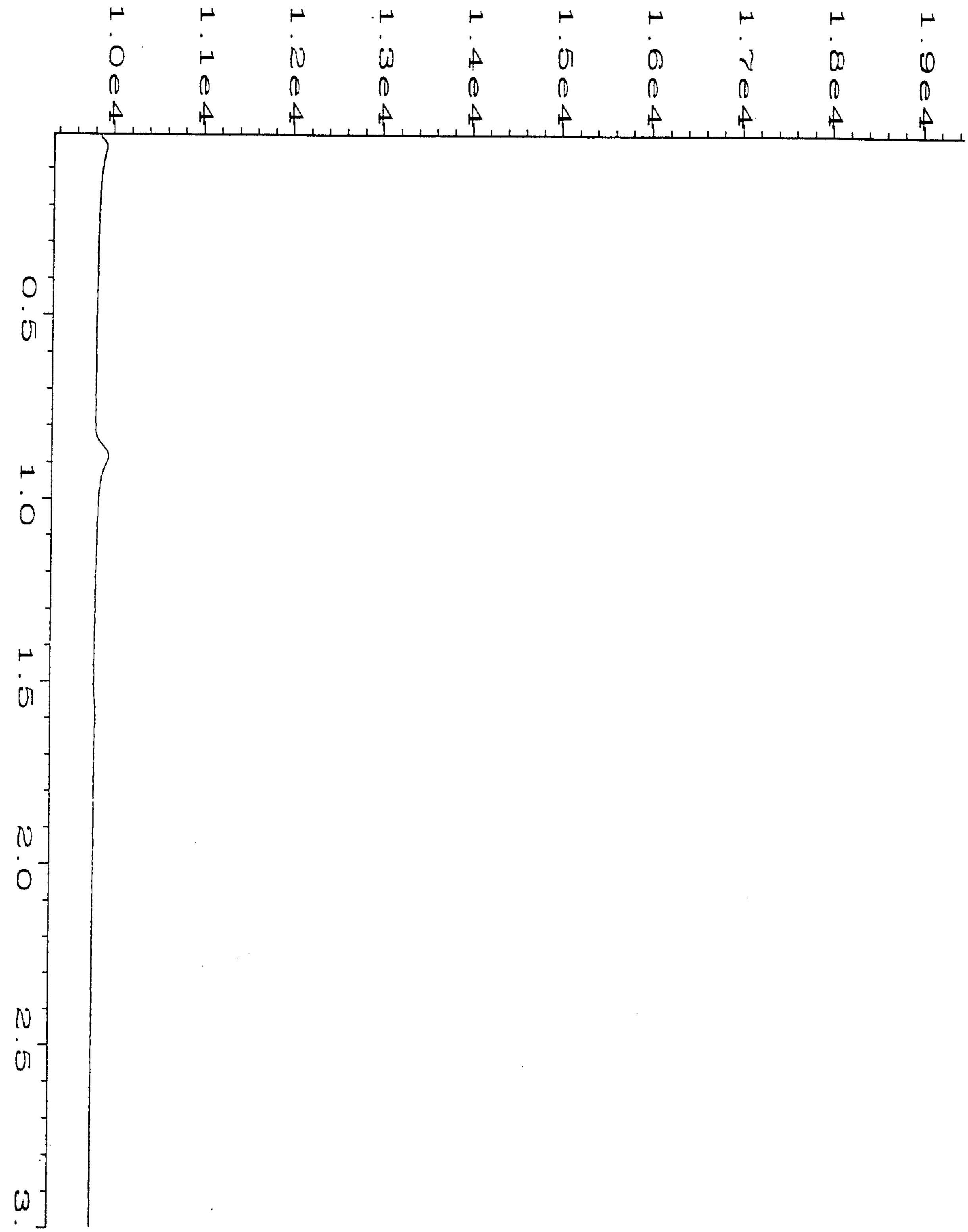
| | | |
|---|---|---|
| Saturation Concentration | Meth | |
| Concentration in Head Space | Meth | |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0686.XLS




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : | C:\HPCHEM\ALCGAS\DATA\GAS0312\022R0101.D | | | |
| Operator | : | Bill Michener | Page Number | : | 1 |
| Instrument | : | ALCGAS | Vial Number | : | 22 |
| Sample Name | : | GB031396 | Injection Number | : | 1 |
| Time Bar Code | : | | Sequence Line | : | 1 |
| Acquired on | : | 13 Mar 96 08:45 AM | Instrument Method | : | METHANE.MTH |
| Report Created on | : | 13 Mar 96 11:20 AM | Analysis Method | : | GAS0313.MTH |
| Last Recalib on | : | 13 MAR 96 08:33 AM | Sample Amount | : | 0 |
| Multiplier | : | 1 | ISTD Amount | : | |
| Sample Info | : | Gas Method Blank | | | |

Displaced 4ml of deionized water in 43ml vial with Helium,
shook for 5 min. and injected 500ul

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## Methane Report Form

| | | | |
|---|---|---|---|
| **Client Sample Number** | : BE-MP20-01 | **Client Project No.** | : 722450.14020 |
| **Lab Sample Number** | : X19943 | **Lab Project No.** | : 96-0686 |
| **Date Sampled** | : 3/8/96 | **Dilution Factor** | : 1.00 |
| **Date Received** | : 3/9/96 | **Method** | : RSKSOP-175 |
| **Date Extracted/Prepared** | : 3/13/96 | **Matrix** | : Water |
| **Date Analyzed** | : 3/13/96 | **Lab File No.** | : GAS0312023 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | |
|---|---|---|---|
| Temperature | : 66.5 F | Saturation Concentration | Meth |
| Amount Injected | : 0.5 ml | | |
| Total Volume of Sample | : 43 ml | Concentration in Head Space | Meth |
| Head space created | : 4 ml | | |
| Methane Area | : 0 ug | | |

Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0686.XLS

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(303) 425-6021

## Analysis Report

| | | | |
|---|---|---|---|
| Date Sampled | : 3/7,8/96 | Client Project ID. | : 722450. 14020 |
| Date Received | : 3/9/96 | Lab Project Number | : 96-0686 |
| Date Prepared | : 3/13/96 | Method | : EPA 415.1 |
| Date Analyzed | : 3/13/96 | Detection Limit | : 1.0 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Total Organic Carbon | | Dilution Factor |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 | Water | 1.2 | mg/L | 1 |
| X19944 | BE-MW02-01 | Water | 1.6 | mg/L | 1 |
| X19945 | BE-MP21-01 | Water | 1.8 | mg/L | 1 |
| X19946 | BE-MW01-01 | Water | 7.3 | mg/L | 1 |
| X19947 | BE-MW18-01 | Water | 2.2 | mg/L | 1 |
| X19948 | BE-MW19-01 | Water | 3.2 | mg/L | 1 |
| Method Blank | (3/13/96) | | <1.0 | | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19943 | BE-MP20-01 Matrix Spike | 10.0 | 1.2 | 12.1 | 109 |
| X19943 | BE-MP20-01 Matrix Spike Dup | 10.0 | 1.2 | 12.1 | 109 |
| MS/MSD RPD | | | | | 0.55 |

Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form
Method Blank Report

| | | | | | |
|---|---|---|---|---|---|
| Method Blank Number | : GB031396 | Client Project No. | : 722450.14020 |
| Date Extracted/Prepared | : 3/13/96 | Lab Project No. | : 96-0686 |
| Date Analyzed | : 3/13/96 | Dilution Factor | : 1.00 |
| | | Method | : RSKSOP-175 |
| | | Matrix | : Water |
| | | Lab File No. | : GAS0312022 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0686.XLS

# CHAIN OF CUSTODY RECORD IALYTICAL SERVICES REQUEST

**Ever en Analytical Inc.**
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400



COMPANY PARSONS ES
ADDRESS 1301 MARINA VILLAGE #200
CITY ALAMEDA STATE CA ZIP 94501
PHONE# 510 769 0100 FAX # 510 769 9244 FAX RESULTS Y / N

CLIENT CONTACT (print) PATTY McCLELLAN
PROJECT I.D. 722450.14020
EAL QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) [signature]
(print) MICHAEL FRIEDMAN

Evergreen Analytical Cooler No. ______
Cooler Received ______

Please **PRINT** all information:

EAL use only
Do not write in shaded area

EAL Project # 96-0686
Custodian KB

| CLIENT SAMPLE IDENTIFICATION | DATE SAMPLED | TIME | No. of Containers | MATRIX: Water-Drinking/Discharge/Ground (circle) | MATRIX: Soil / Solid | MATRIX: Oil / Sludge | TCLP VOA/BNA/Pest/Herb/Metals (circle) | VOA 8260/624/524.2 (circle) | ~~BNA 8270/625 (circle)~~ TOC | Pesticides 8080/608 (circle) | Pest/PCBs 8080/608/508 (circle) | Herbicides 8150/515 (circle) | PCB Screen | BTEX 8020/602 (circle)/MTBE (circle) | TRPH 418.1/Oil & Grease 413.1 (circle) | TVPH 8015mod. (Gasoline) | TEPH 8015mod. (Diesel) | Total Metals-DW / NPDES / SW846 (circle & list metals below) | Dissolved Metals - DW / SW846 (circle & list metals below) | Methane | Ammonia-Dissolved | Alkalinity | Anions (Nitrate, Nitrite, Sulfate, Chloride) | | | EAL Sample No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP20-01 | 3/8/96 | 0920 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | X19943 |
| BE-MW02-01 | 3/8/96 | 1115 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | 44 |
| BE-MP21-01 | 3/8/96 | 1320 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | 45 |
| BE-MW01-01 | 3/8/96 | 1430 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | 46 |
| BE-MW18-01 | 3/7/96 | 1500 | 7 | X | | | | | X | | | | | | | | | | | X | X | X | X | | | 47 |
| BE-MW19-01 | 3/7/96 | 1345 | 6 | X | | | | | X | | | | | | | | | | | X | | X | X | | | 48 |
| | | | | | | | | | | | | | | | | | | | | 3/10 | | No | Bottle KB | | | |

HT:
DD:

Location 2, C4
Container Size 125A, 40V, 500P, 250

Instructions: Analyze for BE-MW19-01 alkalinity and ammonia if sufficient sample volume present per Michael Phelps 3/11/96 pm.

| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time | Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time |
|---|---|---|---|---|---|---|---|
| [signature] | 3/8/96 1100 | [signature] | 3/9/96 1105 | | | | |

# Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3/9/96 1105 Shipped Via: Fedex
(Airbill # if applicable)

Client : Parsons

Client Project ID(s): 722450.14020

EAL Project #(s): 96- 0686 EAL Cooler(s): Y N

| Cooler# | N/A | | | | |
|---|---|---|---|---|---|
| Ice packs | Y N | Y N | Y N | Y N | Y N |
| Temperature °C | 6→8 | | | | |

| | Y | N | N/A |
|---|---|---|---|
| 1. Custody seal(s) present: | ✓ | | |
| Seals on cooler intact | ✓ | | |
| Seals on bottle intact | | | ✓ |
| 2. Chain of Custody present: | ✓ | | |
| 3. Samples Radioactive: (Comment on COC if >0.5mr/h) | | ✓ | |
| 4. Containers broken or leaking: (Comment on COC if Y) | | ✓ | |
| 5. Containers labeled: | ✓ | | |
| 6. COC agrees w/ bottles received: (Comment on COC if N) | ✓ | | |
| 7. COC agrees w/ labels: (Comment on COC if N) | ✓ | | |
| 8. Headspace in vials-waters only: (Comment on COC if Y) | | ✓ | |
| 9. VOA samples preserved: | ✓ | | |
| 10. pH measured on metals, cyanide or phenolics*: | | | ✓ |

List discrepancies ______

*Non-EAL provided containers only, water samples only.

| | Y | N |
|---|---|---|
| 11. Metal samples present: | | ✓ |
| Total ____ , Dissolved ____ , TCLP ____ | | |
| D or PD to be filtered: | | |
| T,TR,D,PD to be Preserved: | | |
| 12. Short holding times: | | ✓ |
| Specify parameters ______ | | |
| 13. Multi-phase sample(s) present: | | ✓ |
| 14. COC signed w/ date/time: | ✓ | |

Comments: Cooler belongs to ITS ANAMETRIX, 1961 Concourse Dr
San Jose CA 95131

(Additional comments on back)

Custodian Signature/Date: JB 3/9/96

# Evergreen Analytical Sample Log Sheet

**Project # 96-0686**

**Date(s) Sampled:** 03/07,08/96 COC

**Date Due:** 03/25/96

**ate Received:** 03/09/96 1105

**Holding Time(s):** 03/09,10-$NO_2$,$NO_3$, 3/21,22-ALKALINITY

**ent Project I.D.** 722450.14020

**Rush** STANDARD

**Client:** PARSONS ENGINEERING SCIENCE, INC.

**Cooler Return** 5.00

**Address:** 1301 MARINA VILLAGE PKWY #200
ALAMEDA, CA 94501

**E.A. Cooler #** N/A

**Airbill #** FEDEX 1154092752

**Contact:** MICHAEL FREIDMAN

**Client P.O.**

**Phone #**510-769-0100 **Fax #**510-769-9244

**Special Invoicing/Billing**

**Special Instructions**

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X19943A | BE-MP20-01 | TOC | W | 125A | C4 |
| X19944A | BE-MW02-01 | TOC | W | 125A | C4 |
| X19945A | BE-MP21-01 | TOC | W | 125A | C4 |
| X19946A | BE-MW01-01 | TOC | W | 125A | C4 |
| 947A | BE-MW18-01 | TOC | W | 125A | C4 |
| X1[illegible]48A | BE-MW19-01 | TOC,AMMONIA | W | 125A | C4 |
| X[illegible]3B-D | BE-MP20-01 | METHANE | W | 40V | C4 |
| X19944B-D | BE-MW02-01 | METHANE | W | 40V | C4 |
| X19945B-D | BE-MP21-01 | METHANE | W | 40V | C4 |
| X19946B-D | BE-MW01-01 | METHANE | W | 40V | C4 |
| X19947B-D | BE-MW18-01 | METHANE | W | 40V | C4 |
| X19948B-D | BE-MW19-01 | METHANE | W | 40V | C4 |
| X19943G | BE-MP20-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X19944G | BE-MW02-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X19945G | BE-MP21-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X19946G | BE-MW01-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X19947G | BE-MW18-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$ | W | 125P | C4 |
| X19948G | BE-MW19-01 | $NO_2$,$NO_3$,$SO_4$,$Cl^-$,ALK. | W | 125P | C4 |
| X19943E | BE-MP20-01 | AMMONIA | W | 500P | C4 |
| X19944E | BE-MW02-01 | AMMONIA | W | 500P | C4 |

R=Sample to be returned

te GC/MS __ GC X Metals __ Wet Chem X HPLC __ SxPrep __

SxRec C QA/QC C Acctg C File Orig



**Custodian/Date:** PKB 3/11/96
Pm 3/12/96

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X19945E | BE-MP21-01 | AMMONIA | W | 500P | C4 |
| X19946E | BE-MW01-01 | AMMONIA | W | 500P | C4 |
| X19947E | BE-MW18-01 | AMMONIA | W | 500P | C4 |
| X19943F | BE-MP20-01 | ALKALINITY | W | 125P | C4 |
| X19944F | BE-MW02-01 | ALKALINITY | W | 125P | C4 |
| X19945F | BE-MP21-01 | ALKALINITY | W | 125P | C4 |
| X19946F | BE-MW01-01 | ALKALINITY | W | 125P | C4 |
| X19947F | BE-MW18-01 | ALKALINITY | W | 125P | C4 |

Page 2 of 2 Pages
Project # 96-0686

R=Sample to be returned

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

# Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/06-07/96 | Client Project ID. | : | 722450.14020 Beale |
| Date Received | : | 3/08/96 | Lab Project Number | : | 96-0673 |
| Date Prepared | : | 3/08/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/08/96 | Detection Limit | : | 0.25 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Sulfate | | Dilution Factor |
|---|---|---|---|---|---|
| X19900 | BE-MP-27-01 | Water | 5.2 | mg/L | 1 |
| X19901 | BE-MP-14-01 | Water | 25.2 | mg/L | 1 |
| X19902 | BE-MP-26-01 | Water | 4.5 | mg/L | 1 |
| X19903 | BE-MP-24-01 | Water | 9.1 | mg/L | 1 |
| X19904 | BE-MP-03-01 | Water | 17.1 | mg/L | 1 |
| X19905 | BE-MP-25-01 | Water | 5.8 | mg/L | 1 |
| Method Blank | (3/8/96) | Water | <0.25 | mg/L | 1 |

## Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19900 | Matrix Spike | 10.0 | 5.2 | 13.8 | 86 |
| X19900 | Matrix Spike Dup | 10.0 | 5.2 | 14.0 | 88 |
| MS/MSD RPD | | | | | 1.8 |

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | |
|---|---|---|---|---|
| Date Sampled | : 3/06-07/96 | Client Project ID. | : | 722450.14020 Beale |
| Date Received | : 3/08/96 | Lab Project Number | : | 96-0673 |
| Date Prepared | : 3/08/96 | Method | : | EPA 300.0 |
| Date Analyzed | : 3/08/96 | Detection Limit | : | 0.076 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrite-N | Dilution Factor |
|---|---|---|---|---|
| X19900 | BE-MP-27-01 | Water | <0.076 mg/L | 1 |
| X19901 | BE-MP-14-01 | Water | <0.076 mg/L | 1 |
| X19902 | BE-MP-26-01 | Water | <0.076 mg/L | 1 |
| X19903 | BE-MP-24-01 | Water | <0.076 mg/L | 1 |
| X19904 | BE-MP-03-01 | Water | <0.076 mg/L | 1 |
| X19905 | BE-MP-25-01 | Water | <0.076 mg/L | 1 |
| Method Blank | (3/8/96) | Water | <0.076 mg/L | 1 |

## Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19900 | Matrix Spike | 10.0 | <0.25 | 10.0 | 100 |
| X19900 | Matrix Spike Dup | 10.0 | <0.25 | 9.6 | 96 |
| MS/MSD RPD | | | | | 4.2 |

Analyst

Approved

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : | 3/06-07/96 | Client Project ID. | : | 722450.14020 Beale |
| Date Received | : | 3/08/96 | Lab Project Number | : | 96-0673 |
| Date Prepared | : | 3/08/96 | Method | : | EPA 300.0 |
| Date Analyzed | : | 3/08/96 | Detection Limit | : | 0.056 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Nitrate-N | | Dilution Factor |
|---|---|---|---|---|---|
| X19900 | BE-MP-27-01 | Water | 1.8 | mg/L | 1 |
| X19901 | BE-MP-14-01 | Water | 4.3 | mg/L | 1 |
| X19902 | BE-MP-26-01 | Water | 1.6 | mg/L | 1 |
| X19903 | BE-MP-24-01 | Water | 2.6 | mg/L | 1 |
| X19904 | BE-MP-03-01 | Water | 2.6 | mg/L | 1 |
| X19905 | BE-MP-25-01 | Water | 1.8 | mg/L | 1 |
| Method Blank | (3/8/96) | Water | <0.056 | mg/L | 1 |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19900 | Matrix Spike | 10.0 | 8.1 | 17.5 | 94 |
| X19900 | Matrix Spike Dup | 10.0 | 8.1 | 17.2 | 91 |
| MS/MSD RPD | | | | | 3.0 |

Analyst

Approved

# EVERGREEN ANALYTICAL, Inc.

4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Analysis Report

Date Sampled : 3/6,7/96
Date Received : 3/8/96
Date Prepared : 3/11/96
Date Analyzed : 3/11/96

Client Project ID. : 722450.14020
Lab Project Number : 96-0673
Method : EPA 310.1
Detection Limit : 5.0 mg $CaCO_3$/L

| Evergreen Sample # | Client Sample ID. | Matrix | Total Alkalinity (mg $CaCO_3$/L) | Dilution Factor |
|---|---|---|---|---|
| X19900 | BE-MP-27-01 | Water | 59.4 | 1 |
| X19901 | BE-MP-14-01 | Water | 287 | 1 |
| X19902 | BE-MP-26-01 | Water | 52.6 | 1 |
| X19903 | BE-MP-24-01 | Water | 52.8 | 1 |
| X19904 | BE-MP-03-01 | Water | 84.4 | 1 |
| X19905 | BE-MP-25-01 | Water | 60.4 | 1 |
| Method Blank | (3/11/96) | Water | <5.0 | 1 |

### Quality Assurance

| Reference | True Value (mg$CaCO_3$/L) | Result (mg$CaCO_3$/L) | % Recovery |
|---|---|---|---|
| ERA-Alkalinity Lot # 0814-95-02 | 120 | 116 | 97 |

Analyst

Approved

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

# Anion Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : 3/06-07/96 | | Client Project ID. | : | 722450.14020 Beale |
| Date Received | : 3/08/96 | | Lab Project Number | : | 96-0673 |
| Date Prepared | : 3/08/96 | | Method | : | EPA 300.0 |
| Date Analyzed | : 3/08/96 | | Detection Limit | : | 0.25 mg/L |

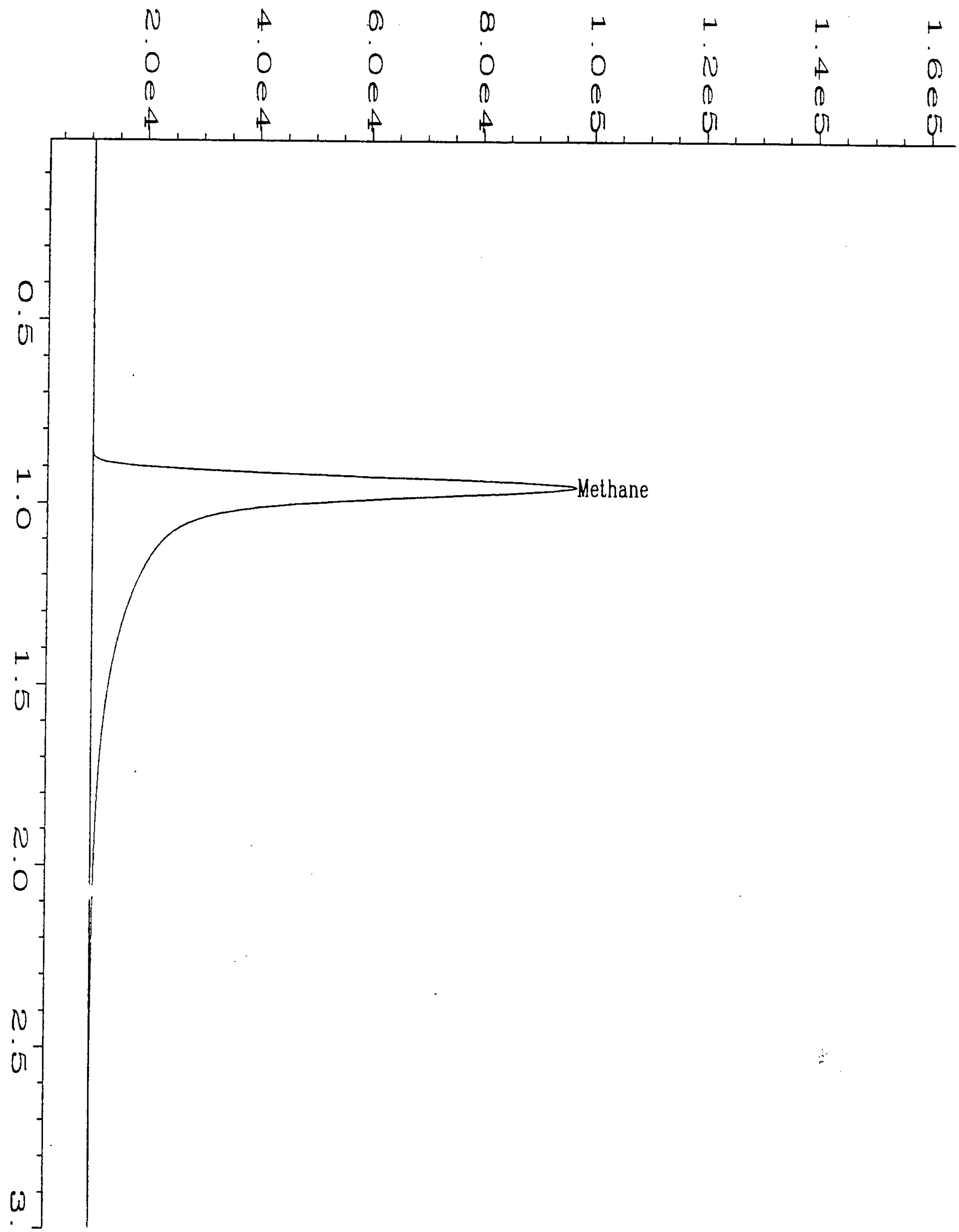
| Evergreen Sample # | Client Sample ID. | Matrix | Chloride | | Dilution Factor |
|---|---|---|---|---|---|
| X19900 | BE-MP-27-01 | Water | 10.2 | mg/L | 1 |
| X19901 | BE-MP-14-01 | Water | 142 | mg/L | 10 |
| X19902 | BE-MP-26-01 | Water | 8.1 | mg/L | 1 |
| X19903 | BE-MP-24-01 | Water | 11.2 | mg/L | 1 |
| X19904 | BE-MP-03-01 | Water | 25.7 | mg/L | 1 |
| X19905 | BE-MP-25-01 | Water | 10.7 | mg/L | 1 |
| Method Blank | (3/8/96) | Water | <0.25 | mg/L | 1 |

## Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19900 | Matrix Spike | 10.0 | 10.2 | 19.2 | 91 |
| X19900 | Matrix Spike Dup | 10.0 | 10.2 | 19.5 | 93 |
| MS/MSD RPD | | | | | 2.6 |

Jeff Hall
Analyst

Approved




| | | | | |
|---|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0312\008R0101.D | | | |
| Operator | : Bill Michener | Page Number | : | 1 |
| Instrument | : ALCGAS | Vial Number | : | 8 |
| Sample Name | : LCS031296;Gas | Injection Number | : | 1 |
| Time Bar Code: | | Sequence Line | : | 1 |
| Acquired on | : 12 Mar 96 09:34 AM | Instrument Method | : | METHANE.MTH |
| Report Created on | : 12 Mar 96 09:41 AM | Analysis Method | : | GAS0312.MTH |
| Last Recalib on | : 12 MAR 96 09:33 AM | Sample Amount | : | 0 |
| Multiplier | : 1 | ISTD Amount | : | |
| Sample Info | : Laboratory Control Sample | | | |

Displaced 4ml of deionized water in 43ml vial with 1% methane gas(#1723), shook for 5 min, and injected 50ul

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Analysis Report

| | | | | | |
|---|---|---|---|---|---|
| Date Sampled | : 3/6,7/96 | | Client Project ID. | : | 722450.14020 |
| Date Received | : 3/8/96 | | Lab Project Number | : | 96-0673 |
| Date Prepared | : 3/8/96 | | Method | : | Standard Method 4500-$NH_3F$ |
| Date Analyzed | : 3/8/96 | | Detection Limit | : | 0.80 mg/L |

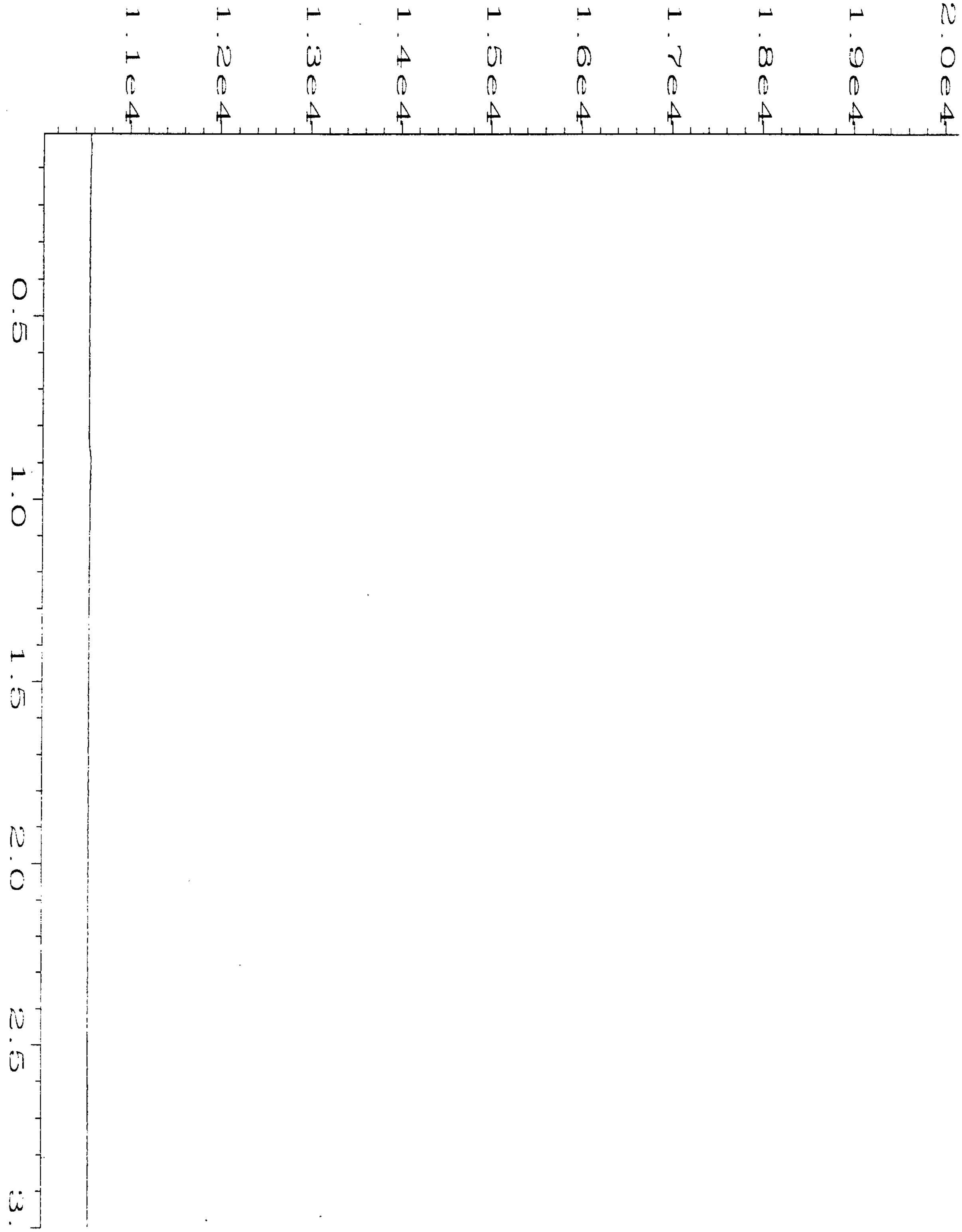
| Evergreen Sample # | Client Sample ID. | Matrix | Ammonia-N | Dilution Factor |
|---|---|---|---|---|
| X19900 | BE-MP-27-01 | Water | <0.80 mg/L | 1 |
| X19901 | BE-MP-14-01 | Water | <0.80 mg/L | 1 |
| X19902 | BE-MP-26-01 | Water | <0.80 mg/L | 1 |
| X19903 | BE-MP-24-01 | Water | <0.80 mg/L | 1 |
| X19904 | BE-MP-03-01 | Water | <0.80 mg/L | 1 |
| X19905 | BE-MP-25-01 | Water | <0.80 mg/L | 1 |
| Method Blank | (3/8/96) | Water | <0.80 mg/L | 1 |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19905 | BE-MP-25-01 Matrix Spike | 10.0 | <0.80 | 10.0 | 100 |
| X19905 | BE-MP-25-01 Matrix Spike Dup | 10.0 | <0.80 | 10.0 | 101 |
| MS/MSD RPD | | | | | 0.79 |

Analyst

Approved




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\016R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19905;1
Time Bar Code:
Acquired on : 12 Mar 96 11:52 AM
Report Created on: 13 Mar 96 11:19 AM
Last Recalib on : 12 MAR 96 09:33 AM
Multiplier : 1
Sample Info : 96-0673;BE-MP-25-01;Water

Page Number : 1
Vial Number : 16
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0312.MTH
Sample Amount : 0
ISTD Amount :

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(303) 425-6021

RSK-175 Gas Method
Methane LCS Report Form

| | | | |
|---|---|---|---|
| LCS No. | : LCS031296 | EPA Method No. | : RSKSOP-175 |
| Date Prepared | : 3/12/96 | Matrix | : Water |
| Date Analyzed | : 3/12/96 | Method Blank | : GB031296 |
| E.A. LCS Source No. | : 1723 | Lab File No. | : GAS0312008 |

| Compound | Spike Added (ug) | Method Blank Concentration (ug) | LCS Concentration (ug) | LCS %REC | QC Limits %REC |
|---|---|---|---|---|---|
| Methane Gas | 500 | 0 | 466 | 93 * | 67-85 |

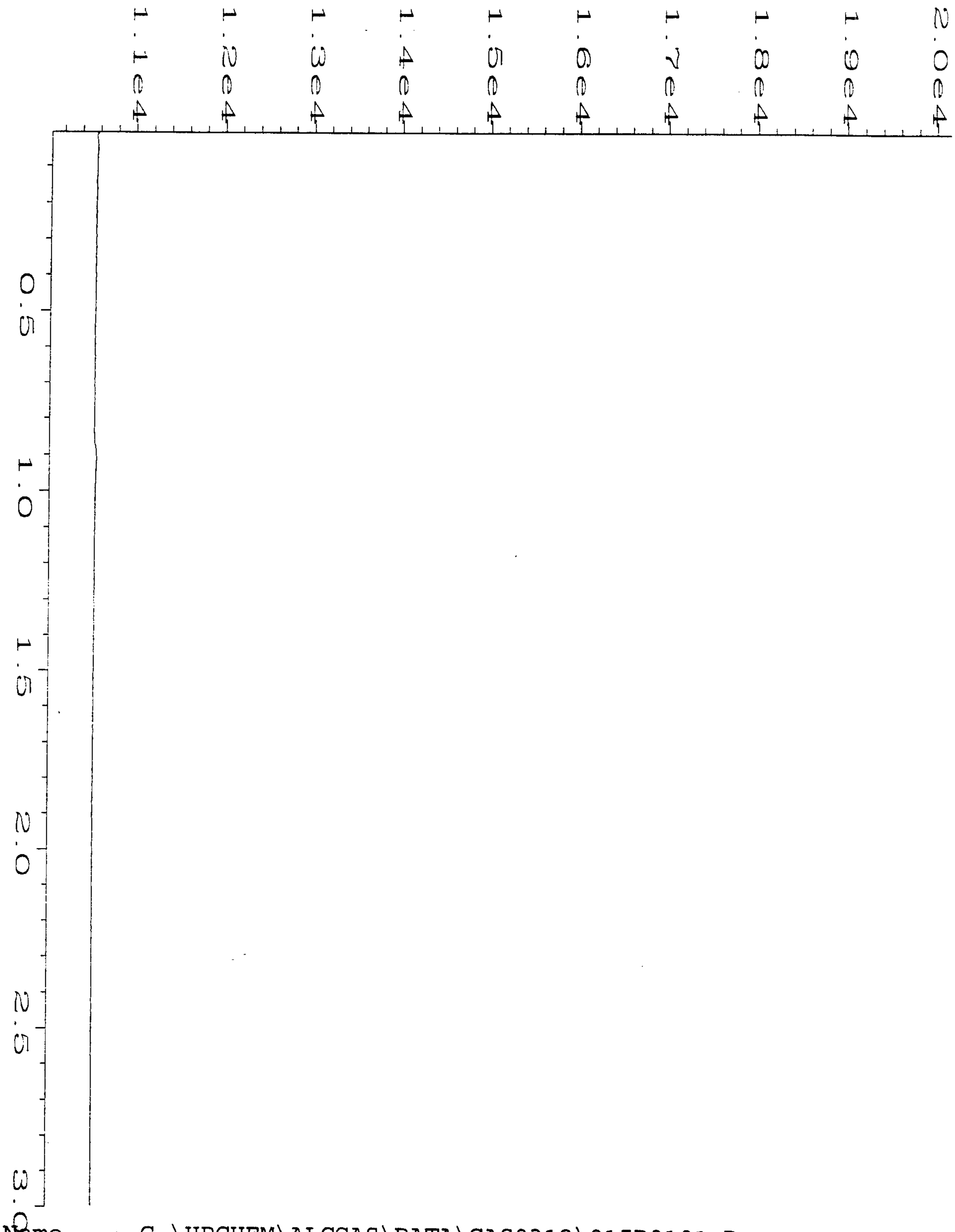
Spike Recovery: 1 out of (1) outside limits.

Note: The LCS was made by taking the sample and displacing 4ml of headspace with a 1% methane gas and shaking the VOA for 5 minutes. Then injecting 50 ul from the headspace into the GC resulting in a theoretical concentration of 500 ug.

NOTES:
* = Values outside of QC limits.
NA = Not analyzed/not available.

Analyst

K. Hollman
Approved




| | | | |
|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0312\015R0101.D | | |
| Operator | : Bill Michener | Page Number | : 1 |
| Instrument | : ALCGAS | Vial Number | : 15 |
| Sample Name | : X19904;1 | Injection Number | : 1 |
| Time Bar Code: | | Sequence Line | : 1 |
| uired on | : 12 Mar 96 11:49 AM | Instrument Method | : METHANE.MTH |
| Re rt Created on | : 13 Mar 96 11:19 AM | Analysis Method | : GAS0312.MTH |
| L Recalib on | : 12 MAR 96 09:33 AM | Sample Amount | : 0 |
| Mu iplier | : 1 | ISTD Amount | : |
| Sample Info | : 96-0673;BE-MP-03-01;Water | | |

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(303) 425-6021

## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP-25-01 | Client Project No. | : 722450.14020 Bea |
| Lab Sample Number | : X19905 | Lab Project No. | : 96-0673 |
| Date Sampled | : 3/7/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/8/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/12/96 | Matrix | : Water |
| Date Analyzed | : 3/12/96 | Lab File No. | : GAS0312016 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | |
|---|---|---|
| Temperature | : | 72.9 F |
| Amount Injected | : | 0.5 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 0 ug |

| | | |
|---|---|---|
| Saturation Concentration | Meth | |
| Concentration in Head Space | Meth | |

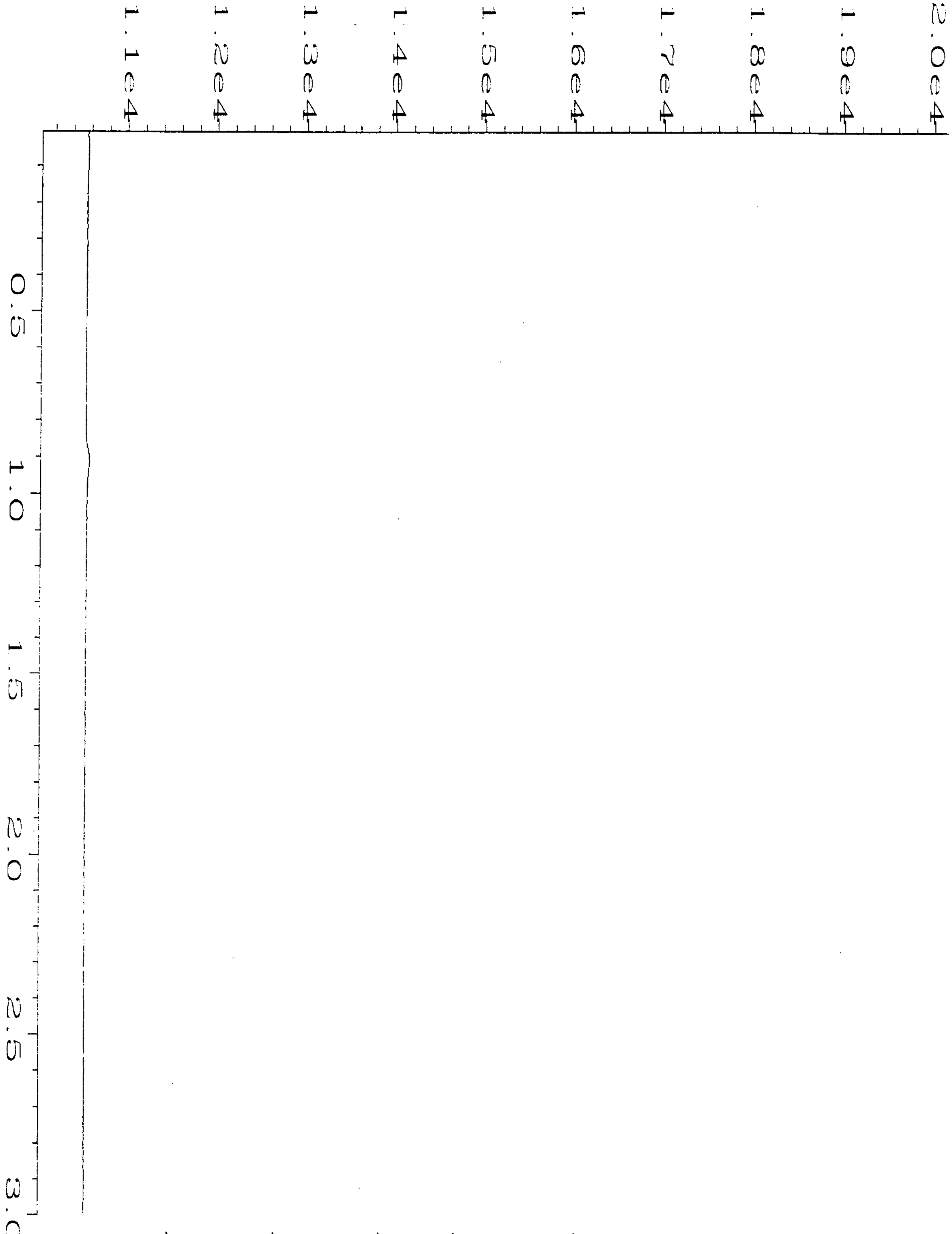
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0673.XLS




| | | | | |
|---|---|---|---|---|
| Data File Name | : C:\HPCHEM\ALCGAS\DATA\GAS0312\014R0101.D | | | |
| Operator | : Bill Michener | Page Number | : | 1 |
| Instrument | : ALCGAS | Vial Number | : | 14 |
| Sample Name | : X19903Dup;1 | Injection Number | : | 1 |
| Time Bar Code: | | Sequence Line | : | 1 |
| uired on | : 12 Mar 96 11:43 AM | Instrument Method | : | METHANE.MTH |
| R rt Created on | : 13 Mar 96 11:19 AM | Analysis Method | : | GAS0312.MTH |
| L Recalib on | : 12 MAR 96 09:33 AM | Sample Amount | : | 0 |
| Mu iplier | : 1 | ISTD Amount | : | |
| Sample Info | : 96-0673;BE-MP-24-01;Water | | | |

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## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP-03-01 | Client Project No. | : 722450.14020 Bea |
| Lab Sample Number | : X19904 | Lab Project No. | : 96-0673 |
| Date Sampled | : 3/7/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/8/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/12/96 | Matrix | : Water |
| Date Analyzed | : 3/12/96 | Lab File No. | : GAS0312015 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | |
|---|---|---|---|
| Temperature | : 72.7 F | Saturation Concentration | Meth |
| Amount Injected | : 0.5 ml | | |
| Total Volume of Sample | : 43 ml | Concentration in Head Space | Meth |
| Head space created | : 4 ml | | |
| Methane Area | : 0 ug | | |

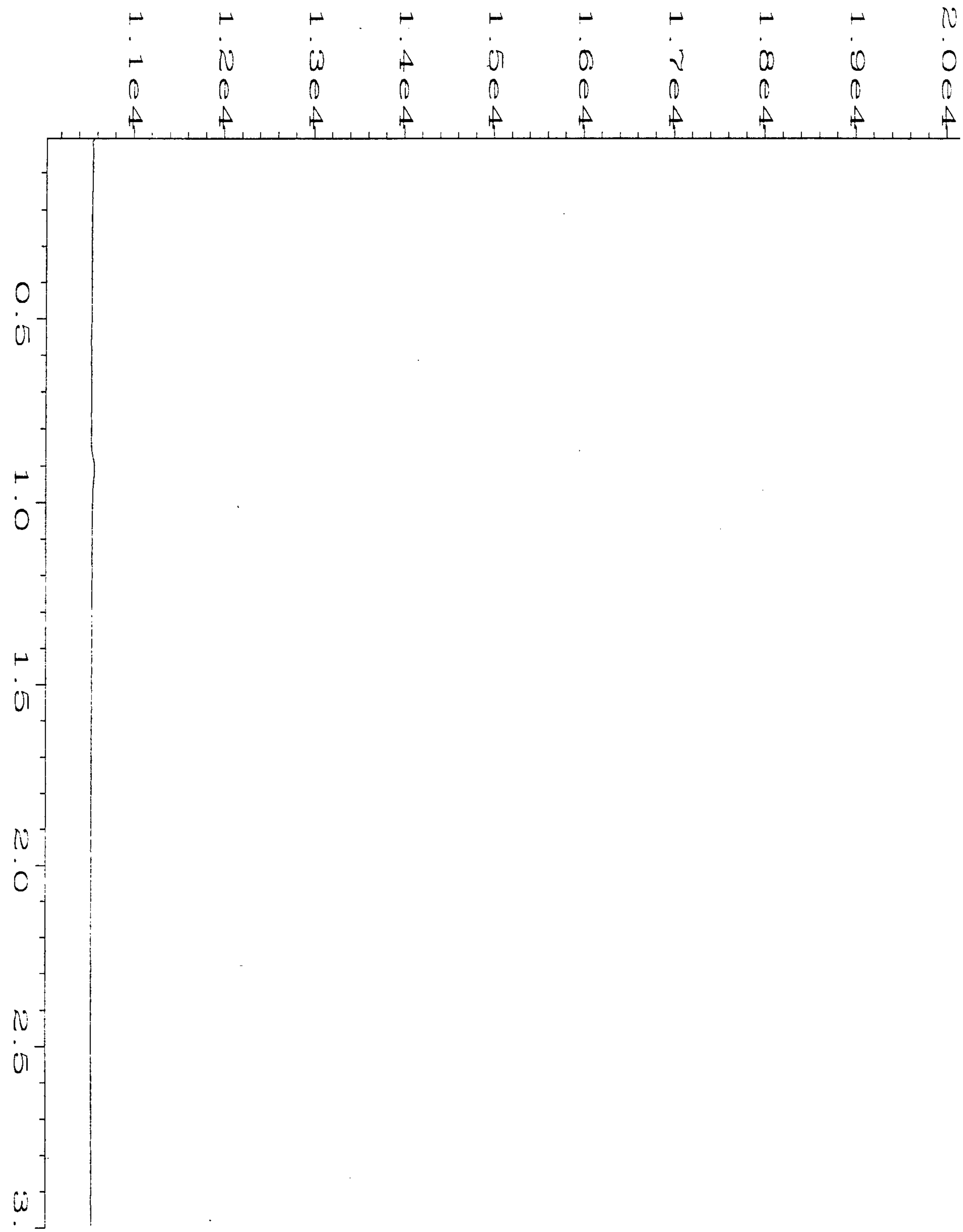
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0673.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\013R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19903;1
Time Bar Code:
Acquired on : 12 Mar 96 11:31 AM
Report Created on: 13 Mar 96 11:19 AM
Last Recalib on : 12 MAR 96 09:33 AM
Multiplier : 1
Sample Info : 96-0673;BE-MP-24-01;Water

Page Number : 1
Vial Number : 13
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0312.MTH
Sample Amount : 0
ISTD Amount :

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(303) 425-6021

# Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP-24-01 | Client Project No. | : 722450.14020 Beal |
| Lab Sample Number | : X19903Dup | Lab Project No. | : 96-0673 |
| Date Sampled | : 3/6/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/8/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/12/96 | Matrix | : Water |
| Date Analyzed | : 3/12/96 | Lab File No. | : GAS0312014 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | | | |
|---|---|---|---|---|
| Temperature | : 72.8 F | Saturation Concentration | Meth | |
| Amount Injected | : 0.5 ml | | | |
| Total Volume of Sample | : 43 ml | Concentration in Head Space | Meth | |
| Head space created | : 4 ml | | | |
| Methane Area | : 0 ug | | | |

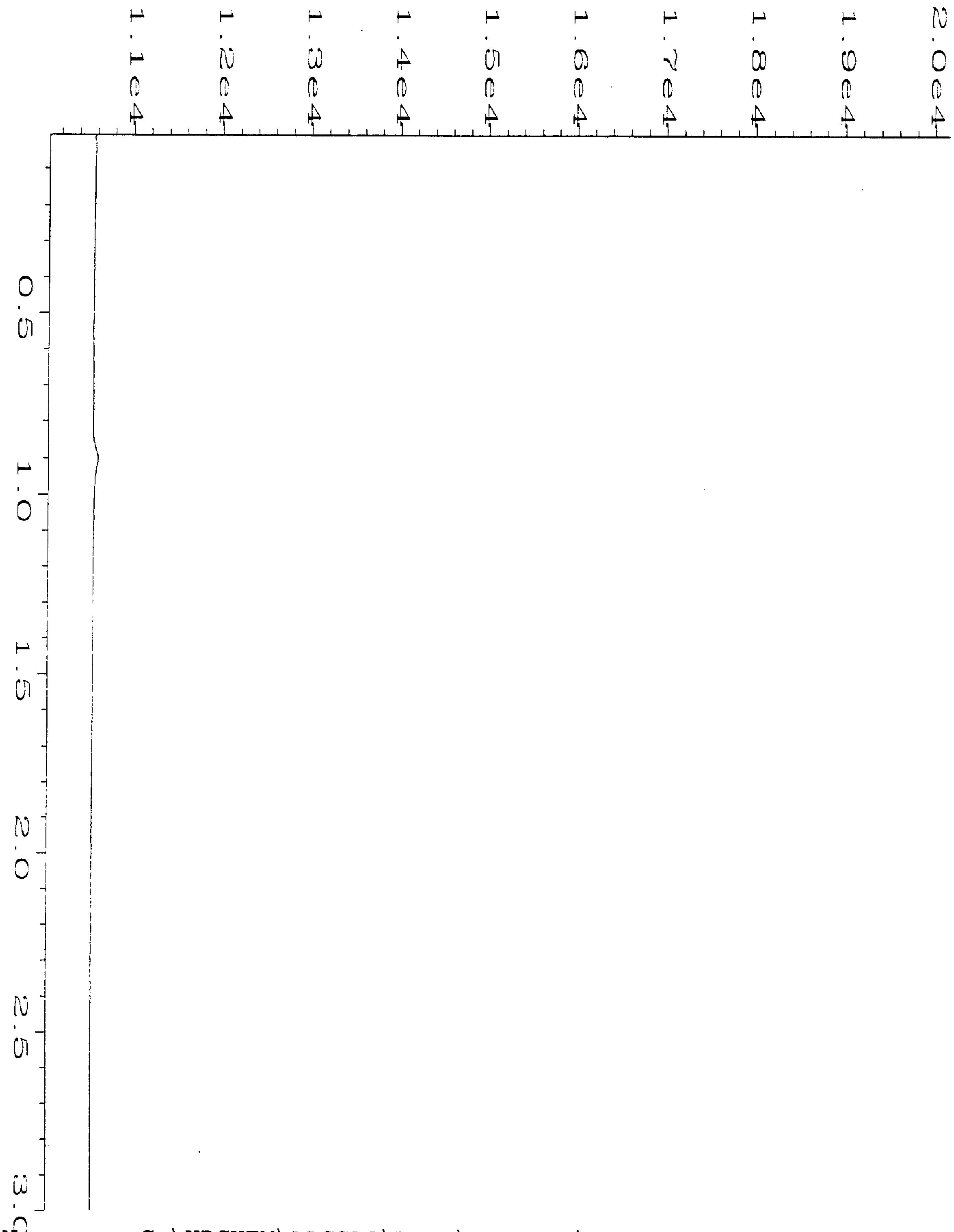
Atomic weight(Methane) : 16 g

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K Hollman
Approved

AF0673.XLS



Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\012R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19902;1
Run Time Bar Code:
Acquired on : 12 Mar 96 11:18 AM
Report Created on: 13 Mar 96 11:19 AM
Last Recalib on : 12 MAR 96 09:33 AM
Multiplier : 1
Sample Info : 96-0673;BE-MP-26-01;Water

Page Number : 1
Vial Number : 12
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0312.MTH
Sample Amount : 0
ISTD Amount :

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## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP-24-01 | Client Project No. | : 722450.14020 Be |
| Lab Sample Number | : X19903 | Lab Project No. | : 96-0673 |
| Date Sampled | : 3/6/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/8/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/12/96 | Matrix | : Water |
| Date Analyzed | : 3/12/96 | Lab File No. | : GAS0312013 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | |
|---|---|---|
| Temperature | : | 72.6 F |
| Amount Injected | : | 0.5 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 0 ug |

| | | |
|---|---|---|
| Saturation Concentration | Meth | |
| Concentration in Head Space | Meth | |

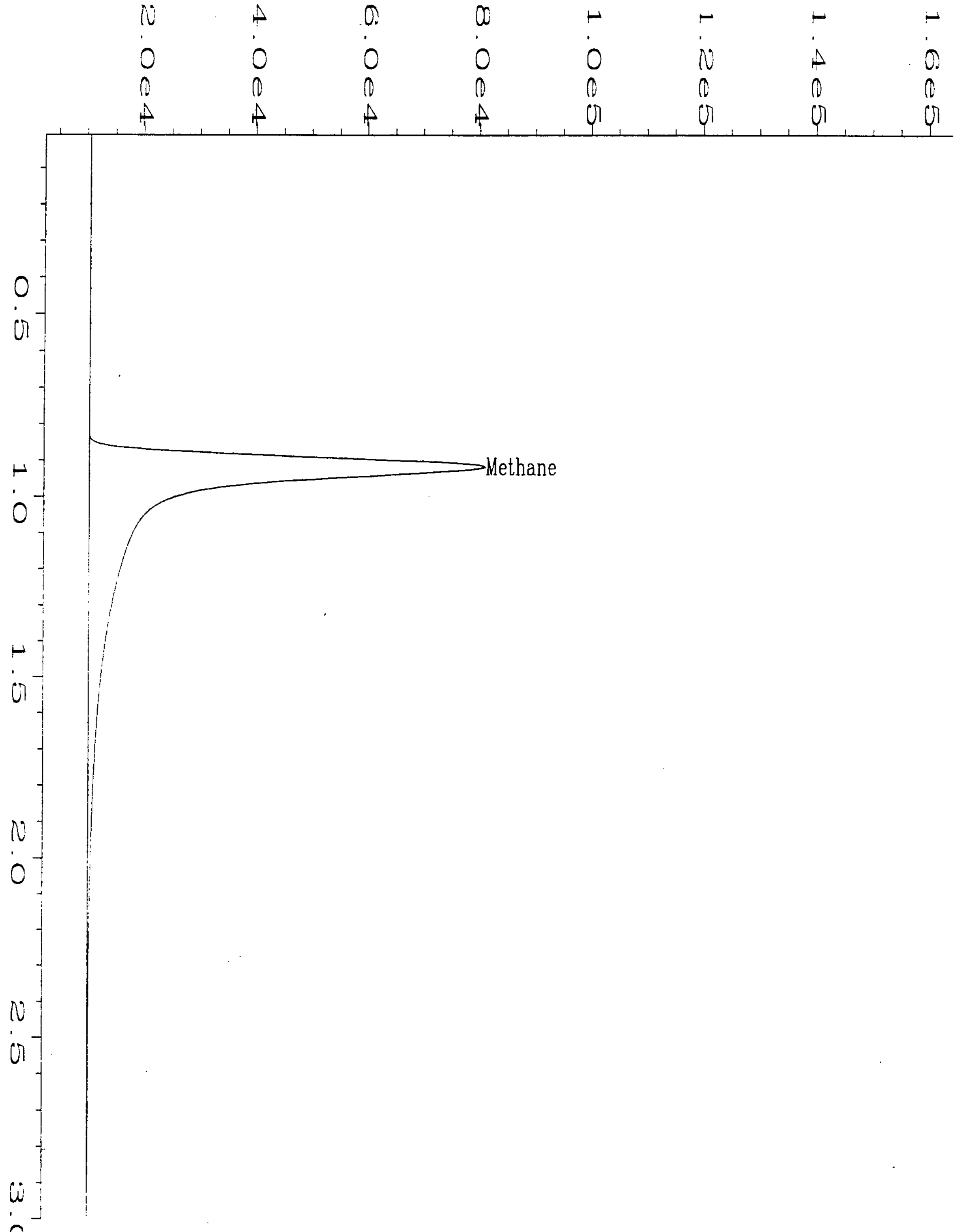
Atomic weight(Methane) : 16 g

**QUALIFIERS:**
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K Hollman
Approved

AF0673.XLS




Data File Name : C:\HPCHEM\ALCGAS\DATA\GAS0312\011R0101.D
Operator : Bill Michener
Instrument : ALCGAS
Sample Name : X19901;50
` Time Bar Code:
. uired on : 12 Mar 96 11:03 AM
R t Created on: 13 Mar 96 11:19 AM
L Recalib on : 12 MAR 96 09:33 AM
Multiplier : 1
Sample Info : 96-0673;BE-MP-14-01;Water

Page Number : 1
Vial Number : 11
Injection Number : 1
Sequence Line : 1
Instrument Method: METHANE.MTH
Analysis Method : GAS0312.MTH
Sample Amount : 0
ISTD Amount :

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## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP-26-01 | Client Project No. | : 722450.14020 Bea |
| Lab Sample Number | : X19902 | Lab Project No. | : 96-0673 |
| Date Sampled | : 3/6/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/8/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/12/96 | Matrix | : Water |
| Date Analyzed | : 3/12/96 | Lab File No. | : GAS0312012 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | |
|---|---|---|
| Temperature | : | 72.6 F |
| Amount Injected | : | 0.5 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 0 ug |
| Atomic weight(Methane) | : | 16 g |

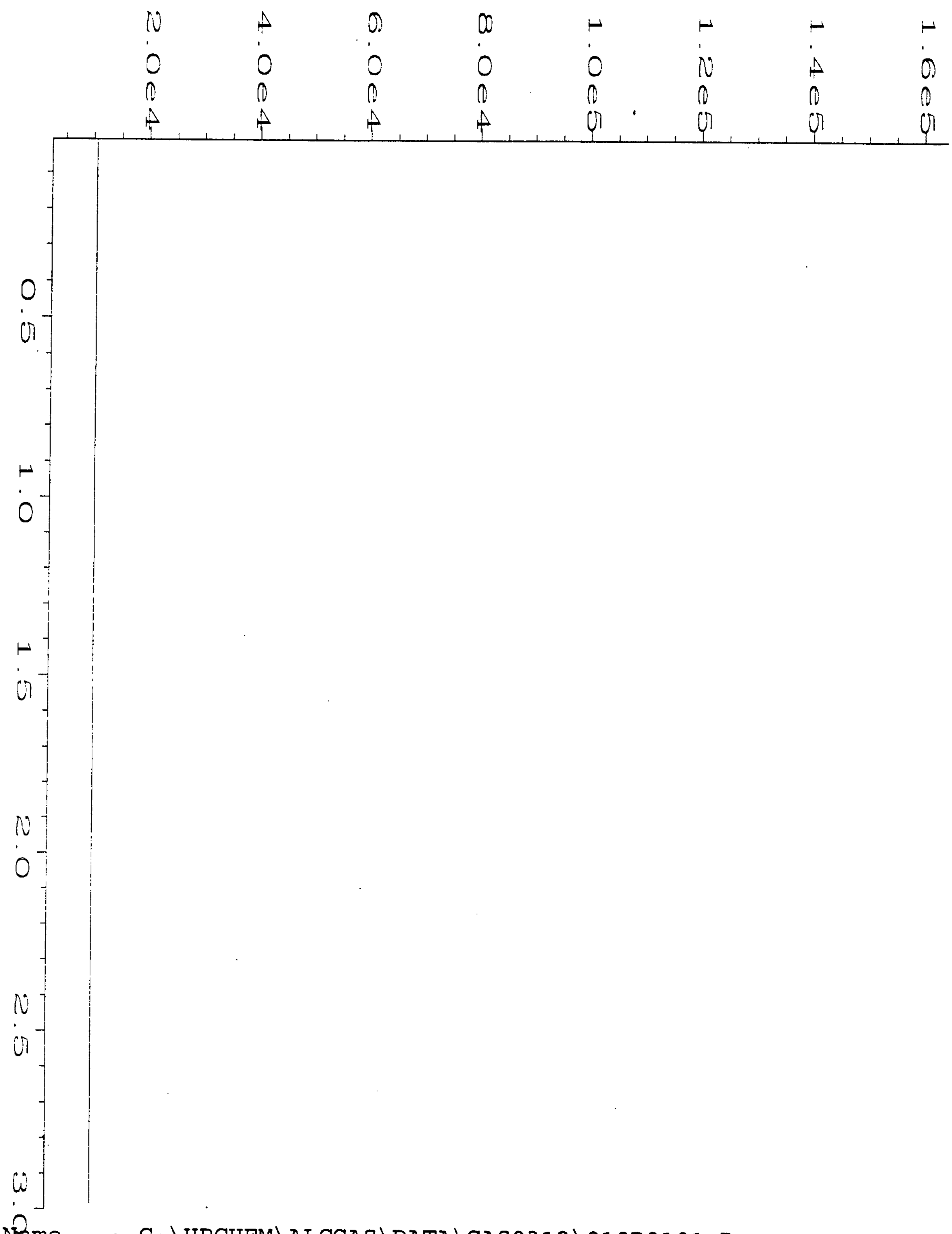
| | | |
|---|---|---|
| Saturation Concentration | Meth | |
| Concentration in Head Space | Meth | |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K Hallman
Approved

AF0673.XLS




| | | | | | |
|---|---|---|---|---|---|
| Data File Name | : | C:\HPCHEM\ALCGAS\DATA\GAS0312\010R0101.D | | | |
| Operator | : | Bill Michener | Page Number | : | 1 |
| Instrument | : | ALCGAS | Vial Number | : | 10 |
| Sample Name | : | X19900;1 | Injection Number | : | 1 |
| ı Time Bar Code | : | | Sequence Line | : | 1 |
| uired on | : | 12 Mar 96 10:15 AM | Instrument Method | : | METHANE.MTH |
| k ort Created on | : | 13 Mar 96 11:19 AM | Analysis Method | : | GAS0312.MTH |
| Recalib on | : | 12 MAR 96 09:33 AM | Sample Amount | : | 0 |
| M tiplier | : | 1 | ISTD Amount | : | |
| Sample Info | : | 96-0673;BE-MP-27-01;Water | | | |

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## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP-14-01 | Client Project No. | : 722450.14020 Bea |
| Lab Sample Number | : X19901 | Lab Project No. | : 96-0673 |
| Date Sampled | : 3/6/96 | Dilution Factor | : 50.00 |
| Date Received | : 3/8/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/12/96 | Matrix | : Water |
| Date Analyzed | : 3/12/96 | Lab File No. | : GAS0312011 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | 3.2 | 0.1 |

| | | | |
|---|---|---|---|
| Temperature | : | 72.3 | F |
| Amount Injected | : | 0.01 | ml |
| Total Volume of Sample | : | 43 | ml |
| Head space created | : | 4 | ml |
| Methane Area | : | 362.229 | ug |
| Atomic weight(Methane) | : | 16 | g |

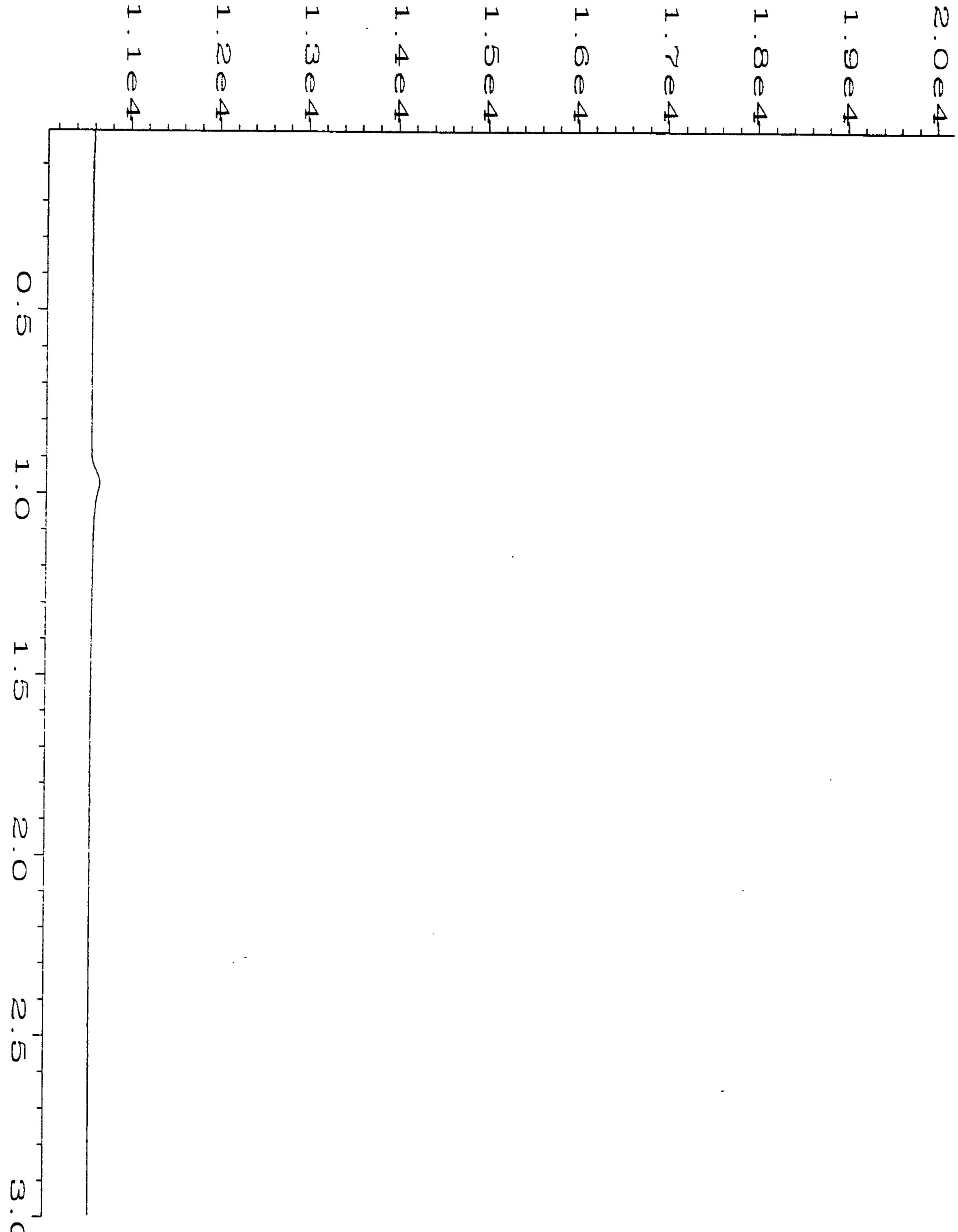
| | | |
|---|---|---|
| Saturation Concentration | Meth | 0.77883 |
| Concentration in Head Space | Meth | 2.452556 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0673.XLS




| | | |
|---|---|---|
| Data File Name | : | C:\HPCHEM\ALCGAS\DATA\GAS0312\002R0101.D |
| Operator | : | Bill Michener |
| Instrument | : | ALCGAS |
| Sample Name | : | GB031296 |
| Time Bar Code | : | |
| Acquired on | : | 12 Mar 96 08:57 AM |
| Report Created on | : | 12 Mar 96 09:41 AM |
| Last Recalib on | : | 12 MAR 96 09:33 AM |
| Multiplier | : | 1 |
| Sample Info | : | Gas Method Blank<br>Displaced 4ml of deionized water in 43ml vial with Helium,<br>shook for 5 min. and injected 500ul |

| | | |
|---|---|---|
| Page Number | : | 1 |
| Vial Number | : | 2 |
| Injection Number | : | 1 |
| Sequence Line | : | 1 |
| Instrument Method | : | METHANE.MTH |
| Analysis Method | : | GAS0312.MTH |
| Sample Amount | : | 0 |
| ISTD Amount | : | |

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## Methane Report Form

| | | | |
|---|---|---|---|
| Client Sample Number | : BE-MP-27-01 | Client Project No. | : 722450.14020 Bea |
| Lab Sample Number | : X19900 | Lab Project No. | : 96-0673 |
| Date Sampled | : 3/6/96 | Dilution Factor | : 1.00 |
| Date Received | : 3/8/96 | Method | : RSKSOP-175 |
| Date Extracted/Prepared | : 3/12/96 | Matrix | : Water |
| Date Analyzed | : 3/12/96 | Lab File No. | : GAS0312010 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

| | | |
|---|---|---|
| Temperature | : | 70.6 F |
| Amount Injected | : | 0.5 ml |
| Total Volume of Sample | : | 43 ml |
| Head space created | : | 4 ml |
| Methane Area | : | 0 ug |

Saturation Concentration Meth ______

Concentration in Head Space Meth ______

| | | |
|---|---|---|
| Atomic weight(Methane) | : | 16 g |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hellman
Approved

AF0673.XLS

**EVERGREEN ANALYTICAL, Inc.**
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

## Total Organic Carbon

| | | | |
|---|---|---|---|
| Date Sampled | : 3/06-07/96 | Client Project ID. | : 722450.14020 Beale |
| Date Received | : 3/08/96 | Lab Project Number | : 96-0673 |
| Date Prepared | : 3/13/96 | Method | : EPA 415.1 |
| Date Analyzed | : 3/13/96 | Detection Limit | : 1.0 mg/L |

| Evergreen Sample # | Client Sample ID. | Matrix | Total Organic Carbon | Dilution Factor |
|---|---|---|---|---|
| X19900 | BE-MP-27-01 | Water | <1.0 mg/L | 1 |
| X19901 | BE-MP-14-01 | Water | 17.6 mg/L | 1 |
| X19902 | BE-MP-26-01 | Water | <1.0 mg/L | 1 |
| X19903 | BE-MP-24-01 | Water | <1.0 mg/L | 1 |
| X19904 | BE-MP-03-01 | Water | 1.4 mg/L | 1 |
| X19905 | BE-MP-25-01 | Water | <1.0 mg/L | 1 |
| Method Blank | (3/13/96) | Water | <1.0 mg/L | |

### Quality Assurance

| | | Spike Amount (mg/L) | Sample Result (mg/L) | Spike Result (mg/L) | % Recovery |
|---|---|---|---|---|---|
| X19900 | Matrix Spike BE-MP-27-01 | 10.0 | <1.0 | 10.2 | 102 |
| X19900 | Matrix Spike Dup BE-MP-27-01 | 10.0 | <1.0 | 10.1 | 101 |
| MS/MSD RPD | | | | | 0.79 |

Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form
Method Blank Report

| | | | |
|---|---|---|---|
| Method Blank Number | : GB031296 | Client Project No. | : 722450.14020 Beale |
| Date Extracted/Prepared | : 3/12/96 | Lab Project No. | : 96-0673 |
| Date Analyzed | : 3/12/96 | Dilution Factor | : 1.00 |
| | | Method | : RSKSOP-175 |
| | | Matrix | : Water |
| | | Lab File No. | : GAS0312002 |

| Compound Name | Cas Number | Sample Concentration mg/L | RL mg/L |
|---|---|---|---|
| Methane | 74-82-8 | U | 0.002 |

QUALIFIERS:
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

K. Hollman
Approved

AF0673.XLS

# CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

**Evergreen Analytical Inc.**
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 1

COMPANY PARSONSES
ADDRESS 1301 MARINA VLLY PKWY ST 200
CITY ALAMEDA STATE CA ZIP 94501
PHONE# 510 769 0100 FAX # 510 769 9244
FAX RESULTS Y / N
FAX COC YES

CLIENT CONTACT (print) Michael Phelps
PROJECT I.D. 722450, 14020 Beale
EAL. QUOTE # ____ P.O.# 722450
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify)____
*expedited turnaround subject to additional fee

Sampler Name: MICHAEL FRIEDMAN
(signature) [signature]
(print) Michael Phelps
Evergreen Analytical Cooler No.____
Cooler Received____

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL Project # 96-0673
Custodian MJM

| CLIENT SAMPLE IDENTIFICATION | DATE SAMPLED | TIME | No. of Containers | MATRIX: Water-Drinking/Discharge/Ground (circle) | MATRIX: Soil / Solid | MATRIX: Oil / Sludge | TCLP VOA/BNA/Pest/Herb/Metals (circle) | VOA 8260/624/524.2 (circle) | ~~BNA 8270/625 (circle)~~ TOC | Pesticides 8080/608 (circle) | Pest/PCBs 8080/608/508 (circle) | Herbicides 8150/515 (circle) | PCB Screen | BTEX 8020/602 (circle)/MTBE (circle) | TRPH 418.1/Oil & Grease 413.1 (circle) | TVPH 8015mod. (Gasoline) | TEPH 8015mod. (Diesel) | Total Metals-DW / NPDES / SW846 (circle & list metals below) | Dissolved Metals - DW / SW846 (circle & list metals below) | Methane | Ammonia, Dissolved | Alkalinity | Anions (Nitrate, Nitrite, Sulfate & Chloride) | | | EAL Sample No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP-27-01 | 3/6/96 | 1540 | 7 | | | | | | X | | | | | | | | | | | X | X | X | X | | | X19900 |
| BE-MP-14-01 | 3/6/96 | 1225 | 7 | | | | | | X | | | | | | | | | | | X | X | X | X | | | 901 |
| BE-MP-26-01 | 3/6/96 | 1425 | 7 | | | | | | X | | | | | | | | | | | X | X | X | X | | | 902 |
| BE-MP-24-01 | 3/6/96 | 0930 | 7 | | | | | | X | | | | | | | | | | | X | X | X | X | | | 903 |
| BE-MP-03-01 | 3/7/96 | 1130 | 7 | | | | | | X | | | | | | | | | | | X | X | X | X | | | 904 |
| BE-MP-25-01 | 3/7/96 | 0945 | 7 | | | | | | X | | | | | | | | | | | X | X | X | X | | | 905 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HT: | | | | | | | | | A | | | | | | | | | | | B-D | E | F | G | | | Location C2,2 |
| DD: | | | | | | | | | 125 A | | | | | | | | | | | 40 V | 500 P | 125 P | 125 P | | | Container Size ← |

Instructions:

| Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time | Relinquished by: (Signature) | Date/Time | Received by: (Signature) | Date/Time |
|---|---|---|---|---|---|---|---|
| [signature] | 3/7/96 1800 | | | | | [signature] | 3/8/96 0935 |

# Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3/8/96 0935 Shipped Via: Fed-X
(Airbill # 1154092763

Client : Parsons ES

Client Project ID(s): 722450.14020 Beale

EAL Project #(s): 96-0673 EAL Cooler(s): Y N

| Cooler# | 720 | | | | |
|---|---|---|---|---|---|
| Ice packs | Y N | Y N | Y N | Y N | Y N |
| Temperature °C | 5 | | | | |

| | Y | N | N/A |
|---|---|---|---|
| 1. Custody seal(s) present: | X | | |
| Seals on cooler intact | X | | |
| Seals on bottle intact | | | X |
| 2. Chain of Custody present: | X | | |
| 3. Samples Radioactive: (Comment on COC if >0.5mr/h) | | X | |
| 4. Containers broken or leaking: (Comment on COC if Y) | | X | |
| 5. Containers labeled: | X | | |
| 6. COC agrees w/ bottles received: (Comment on COC if N) | X | | |
| 7. COC agrees w/ labels: (Comment on COC if N) | X | | |
| 8. Headspace in vials-waters only: (Comment on COC if Y) | | X | |
| 9. VOA samples preserved: - Methanol. | X | | |
| 10. pH measured on metals, cyanide or phenolics*: | | | X |
| List discrepancies | | | |
| *Non-EAL provided containers only, water samples only. | | | |
| 11. Metal samples present: | | X | |
| Total ____ , Dissolved ____ , TCLP ____ | | | |
| D or PD to be filtered: | | | |
| T,TR,D,PD to be Preserved: | | | |
| 12. Short holding times: | X | | |
| Specify parameters $NO_2/NO_3$ | | | |
| 13. Multi-phase sample(s) present: | | X | |
| 14. COC signed w/ date/time: | X | | |

Comments:

(Additional comments on back)

Custodian Signature/Date: Mym 3/8/96

# Evergreen Analytical Sample Log Sheet

**Project # 96-0673**

**Dat (s) Sampled:** 03/06,07/96 COC

**Date Due:** 03/22/96

**te Received:** 03/08/96 0935

**Holding Time(s):** 03/08,09-$NO_2$,$NO_3$
3/20,21-ALKALINITY

**nt Project I.D.** 722450.14020 BEALE

**Rush** STANDARD

**Client:** PARSONS ENGINEERING SCIENCE, INC.
**Address:** 1301 MARINA VILLAGE PKWY #200
ALAMEDA, CA 94501
**Contact:** MICHAEL PHELPS
**Phone #**510-769-0100 **Fax #**510-769-9244

**Cooler Return** N/A
**E.A. Cooler #** 720
**Airbill #** FEDEX 1154092763
**Client P.O.** 722450

**Special Invoicing/Billing**

**Special Instructions**

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X19900A | BE-MP-27-01 | TOC | W | 125A | C2 |
| X19901A | BE-MP-14-01 | TOC | W | 125A | C2 |
| 9902A | BE-MP-26-01 | TOC | W | 125A | C2 |
| ..9903A | BE-MP-24-01 | TOC | W | 125A | C2 |
| 04A | BE-MP-03-01 | TOC | W | 125A | C2 |
| X19905A | BE-MP-25-01 | TOC | W | 125A | C2 |
| X19900B-D | BE-MP-27-01 | METHANE | W | 40V | 2 |
| X19901B-D | BE-MP-14-01 | METHANE | W | 40V | 2 |
| X19902B-D | BE-MP-26-01 | METHANE | W | 40V | 2 |
| X19903B-D | BE-MP-24-01 | METHANE | W | 40V | 2 |
| X19904B-D | BE-MP-03-01 | METHANE | W | 40V | 2 |
| X19905B-D | BE-MP-25-01 | METHANE | W | 40V | 2 |
| X19900E | BE-MP-27-01 | AMMONIA | W | 500P | C2 |
| X19901E | BE-MP-14-01 | AMMONIA | W | 500P | C2 |
| X19902E | BE-MP-26-01 | AMMONIA | W | 500P | C2 |
| X19903E | BE-MP-24-01 | AMMONIA | W | 500P | C2 |
| X19904E | BE-MP-03-01 | AMMONIA | W | 500P | C2 |
| X19905E | BE-MP-25-01 | AMMONIA | W | 500P | C2 |

R=Sample to be returned

ıte GC/MS __ GC X Metals __ Wet Chem X HPLC __ SxPrep __

SxRec C QA/QC C Acctg C File Orig



**Custodian/Date:** MJM/PLB 3/8/96
Dm 3/8/96

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X19900F | BE-MP-27-01 | ALKALINITY | W | 125P | C2 |
| X19901F | BE-MP-14-01 | ALKALINITY | W | 125P | C2 |
| X19902F | BE-MP-26-01 | ALKALINITY | W | 125P | C2 |
| X19903F | BE-MP-24-01 | ALKALINITY | W | 125P | C2 |
| X19904F | BE-MP-03-01 | ALKALINITY | W | 125P | C2 |
| X19905F | BE-MP-25-01 | ALKALINITY | W | 125P | C2 |
| X19900G | BE-MP-27-01 | $NO_2, NO_3, SO_4, Cl^-$ | W | 40V | 2 |
| X19901G | BE-MP-14-01 | $NO_2, NO_3, SO_4, Cl^-$ | W | 40V | 2 |
| X19902G | BE-MP-26-01 | $NO_2, NO_3, SO_4, Cl^-$ | W | 40V | 2 |
| X19903G | BE-MP-24-01 | $NO_2, NO_3, SO_4, Cl^-$ | W | 40V | 2 |
| X19904G | BE-MP-03-01 | $NO_2, NO_3, SO_4, Cl^-$ | W | 40V | 2 |
| X19905G | BE-MP-25-01 | $NO_2, NO_3, SO_4, Cl^-$ | W | 40V | 2 |



Project # 96-0673

R=Sample to be returned

MAR

**Hazen Research, Inc.**
4601 Indiana St. • Golden, Colo. 80403
Tel: (303) 279-4501 • Telex 45-860
FAX: (303) 278-1528

| | |
|---|---|
| Date | March 7 1996 |
| HRI Project | 009-93 |
| HRI Series No. | C038/96 |
| Date Rec'd. | 03/01/96 |
| Cust. P.O. # | |

Evergreen Analytical Inc.
Carl Smits
4036 Youngfield
Wheat Ridge CO 80033

# SCREEN ANALYSIS REPORT

Sample Number: C038/96-1
Sample Identification: 96-0587 BE-MP24-3 02/26/96 @ 1110

| Mesh Size Pass-Retained | Direct Weight,g | Direct Weight,% | Cum Weight % Retained | Cum Weight % Pass |
|---|---|---|---|---|
| - 4 | 14.1 | 5.55 | 5.55 | 94.45 |
| 4 - 6 | 4.4 | 1.73 | 7.28 | 92.72 |
| 6 - 8 | 5.2 | 2.04 | 9.32 | 90.68 |
| 8 - 10 | 3.2 | 1.26 | 10.58 | 89.42 |
| 10 - 14 | 4.8 | 1.89 | 12.47 | 87.53 |
| 14 - 20 | 4.6 | 1.81 | 14.28 | 85.72 |
| 20 - 28 | 4.6 | 1.81 | 16.09 | 83.91 |
| 28 - 35 | 5.7 | 2.24 | 18.33 | 81.67 |
| 35 - 48 | 7.5 | 2.95 | 21.28 | 78.72 |
| 48 - 65 | 8.9 | 3.50 | 24.78 | 75.22 |
| 65 - 100 | 8.7 | 3.42 | 28.20 | 71.80 |
| 100 - 150 | 11.0 | 4.33 | 32.53 | 67.47 |
| 150 - 200 | 11.4 | 4.48 | 37.01 | 62.99 |
| 200 - 270 | 15.3 | 6.02 | 43.03 | 56.97 |
| 270 - 325 | 3.6 | 1.42 | 44.45 | 55.55 |
| 325 - PAN | 141.2 | 55.55 | 100.00 | 0.00 |
| Total | 254.2 | 100.00 | | |

By:

Robert Rostad
Laboratory Manager

Screen sizes are in Tyler Mesh.

Project # 96-0869, 0587

# % MOISTURE

3/25/96

$$\frac{(A-B)}{C} \times 100$$

| | | | | A | B | C | | |
|---|---|---|---|---|---|---|---|---|
| | Sample # | pH | Tin | Tin + Sample | Tin + Sample Dry | Net Wt. of Wet Sample | % Moisture | Original Sample Wt |
| 0869 1 | x20886 | | 1.12 | 17.16 | 14.36 | 16.04 | 17.45 | |
| 2 | 887 | | 1.16 | 16.11 | 13.41 | 14.95 | 18.06 | |
| 3 | 888 | | 1.12 | 15.13 | 12.94 | 14.01 | 15.63 | |
| 4 | 889 | | 1.14 | 14.48 | 12.61 | 13.34 | 7.49 | |
| 5 | 890 | | 1.14 | 14.86 | 12.15 | 13.72 | 19.75 | |
| 6 | 891 | | 1.13 | 12.52 | 10.06 | 11.39 | 21.59 | |
| 7 | 892 | | 1.13 | 14.04 | 11.48 | 12.91 | 7.74 | |
| 8 | 893 | | 1.14 | 15.14 | 13.15 | 14.00 | 14.21 | |
| 0587 9 | x19542 | | 1.09 | 16.27 | 14.14 | 15.18 | 6.58 | |
| 10 | 543 | | 1.13 | 16.22 | 14.43 | 15.09 | 6.62 | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |
| 17 | | | | | | | | |
| 18 | | | | | | | | |
| 19 | | | | | | | | |
| 20 | | | | | | | | |
| 21 | | | | | | | | |
| 22 | | | | | | | | |
| 23 | | | | | | | | |
| 24 | | | | | | | | |

**HUFFMAN**
LABORATORIES, INC.
*Quality Analytical Services Since 1936*
4630 Indiana Street • Golden, CO 80403

| ANALYSIS | CARBONATE CARBON | METHOD | SOP COU-02 |
|---|---|---|---|
| ANALYZER # | 6 | COULOMETER # | 2 |
| BALANCE # | 10 | | |

| ALCIUM CARBONATE (STD # 133) $CaCO_3$ | BOTTLE # 4712 | % C THEORY = 12.00% | SODIUM CARBONATE (STD # 134) $Na_2CO_3$ | BOTTLE # 2730+4713 | %C THEORY = 11.33 % |
|---|---|---|---|---|---|

| MPLE NO. | TARE WT. GRAMS | TARE + SAMPLE WT. | SAMPLE WT. GRAMS | NOTES | (COUNTS) µ GRAMS CARBON | LESS BLANK 7 | % CARBONATE CARBON AS CARBON | QC | % RECOVERY |
|---|---|---|---|---|---|---|---|---|---|
| 125601 | 0.896936 | 1.783341 | 0.886405 | NH | (1357.9) | 1350.9 | | | |
| 133 | 0.877370 | 0.888844 | 0.011474 | Spike | | | | | |
| 125601 | 0.888038 | 1.757185 | 0.869147 | NH | (1310.9) | 1303.9 | | | |
| 133 | 0.911120 | 0.922427 | 0.011307 | Spike | | | | | |
| 133 | 0.928347 | 0.938767 | 0.010420 | | 1247.6 | 1240.6 ~~1247.~~ | ~~11.90~~ 3-7 11.91 | CCS | 99.2 |
| [redacted] | | | | | | | | | |
| 133 | 0.895643 | 0.906087 | 0.010444 | | 1244.9 | 1237.9 | 11.85 | CCS | 98.8 |

| ANALYST | DATE | REVIEWED | DATE | PAGE |
|---|---|---|---|---|
| Miller | 3-7-96 | [illegible] | 3/8/96 | PAGE 2 OF 2 |

REVISED 7/13/95

MAR 0 8 ...

**Hazen Research, Inc.**
4601 Indiana St. • Golden, Colo. 80403
Tel: (303) 279-4501 • Telex 45-860
FAX: (303) 278-1528

Date March 7 1996
HRI Project 009-93
HRI Series No. C038/96
Date Rec'd. 03/01/96
Cust. P.O. #

Evergreen Analytical Inc.
Carl Smits
4036 Youngfield
Wheat Ridge CO 80033

# SCREEN ANALYSIS REPORT

Sample Number: C038/96-2
Sample Identification: 96-0587 BE-MP25-7 02/28/96 @ 1040

| Mesh Size Pass-Retained | Direct Weight,g | Direct Weight,% | Cum Weight % Retained | Cum Weight % Pass |
|---|---|---|---|---|
| - 4 | 64.8 | 24.56 | 24.56 | 75.44 |
| 4 - 6 | 16.3 | 6.18 | 30.74 | 69.26 |
| 6 - 8 | 14.8 | 5.61 | 36.35 | 63.65 |
| 8 - 10 | 14.6 | 5.54 | 41.89 | 58.11 |
| 10 - 14 | 18.0 | 6.82 | 48.71 | 51.29 |
| 14 - 20 | 19.3 | 7.32 | 56.03 | 43.97 |
| 20 - 28 | 21.2 | 8.04 | 64.07 | 35.93 |
| 28 - 35 | 20.7 | 7.85 | 71.92 | 28.08 |
| 35 - 48 | 15.1 | 5.72 | 77.64 | 22.36 |
| 48 - 65 | 7.5 | 2.84 | 80.48 | 19.52 |
| 65 - 100 | 4.0 | 1.52 | 82.00 | 18.00 |
| 100 - 150 | 3.5 | 1.33 | 83.33 | 16.67 |
| 150 - 200 | 2.8 | 1.06 | 84.39 | 15.61 |
| 200 - 270 | 2.7 | 1.02 | 85.41 | 14.59 |
| 270 - 325 | 0.5 | 0.19 | 85.60 | 14.40 |
| 325 - PAN | 38.0 | 14.40 | 100.00 | 0.00 |
| Total | 263.8 | 100.00 | | |

By: [signature]
Robert Rostad
Laboratory Manager

Screen sizes are in Tyler Mesh.

HUFFMAN
LABORATORIES, INC.
Quality Analytical Services Since 1936
4630 Indiana Street • Golden, CO 80403

| ANALYSIS | CARBONATE CARBON | METHOD | SOP COU-02 |
|---|---|---|---|
| ANALYZER # | 6 | COULOMETER # | 2 |
| BALANCE # | 10 | | |

| ALCIUM CARBONATE (STD # 133) $CaCO_3$ | BOTTLE # 4712 | % C THEORY = 12.00% | SODIUM CARBONATE (STD # 134) $Na_2CO_3$ | BOTTLE # 273074713 | %C THEORY = 11.33 % |
|---|---|---|---|---|---|

| MPLE NO. | TARE WT. GRAMS | TARE + SAMPLE WT. | SAMPLE WT. GRAMS | NOTES | (COUNTS) µ GRAMS CARBON | LESS BLANK 7 | % CARBONATE CARBON AS CARBON | QC | % RECOVERY |
|---|---|---|---|---|---|---|---|---|---|
| [redacted] | | | | | | | | | |
| Bl | | | | | 8.0 | | | IB | |
| Bl | | | | | 7.0 | | | MB | |
| [redacted] | | | | | | | | | |
| 133 | 0.877466 | 0.888050 | 0.010584 | | 1272.6 | 1265.6 | 11.96 | ICS | 99.6 |
| 133 | 0.885226 | 0.896070 | 0.010844 | | 1299.9 | 1292.9 | 11.92 | CCS | 99.3 |
| 134 | 0.847530 | 0.877760 | 0.010230 | | 1157.2 | 1150.2 | 11.24 | LCS | 99.2 |
| [redacted] | | | | | | | | | |
| 125601 | 0.855974 | 1.502674 | 0.646700 | | 8.8 | 1.8 | <0.01 | | |
| 601 | 0.898799 | 1.925798 | 1.026999 ~~0.~~ xm 2.5 | | 7.4 | 0.4 | <0.01 | | |
| 125602 | 0.862578 | 1.776263 | 0.913685 | | 7.4 | 0.4 | <0.01 | | |
| [redacted] | | | | | | | | | |
| 133 | 0.882893 | 0.893472 | 0.010579 | | 1277.6 | 1270.6 | 12.01 | CCS | 100.1 |

126 needs dup/spikes

| ANALYST | DATE 3-5-96 | REVIEWED RLK | DATE 030596 | PAGE 1 OF 1 |
|---|---|---|---|---|

REVISED 7/13/95

**HUFFMAN LABORATORIES, INC.**
*Quality Analytical Services Since 1936*
4630 Indiana Street • Golden, CO 80403

| ANALYSIS | CARBONATE CARBON | METHOD | SOP COU-02 |
|---|---|---|---|
| ANALYZER # | 6 | COULOMETER # | 2 |
| BALANCE # | 10 | | |

| CALCIUM CARBONATE (STD # 133) $CaCO_3$ | BOTTLE # 4712 | % C THEORY = 12.00% | SODIUM CARBONATE (STD # 134) $Na_2CO_3$ | BOTTLE # 2732-14713 | %C THEORY = 11.33 % |
|---|---|---|---|---|---|

| SAMPLE NO. | TARE WT. GRAMS | TARE + SAMPLE WT. | SAMPLE WT. GRAMS | NOTES | (COUNTS) µ GRAMS CARBON | LESS BLANK 7 | % CARBONATE CARBON AS CARBON | QC | % RECOVERY |
|---|---|---|---|---|---|---|---|---|---|
| [redacted] | | | | | | | | | |
| B1 | | | | | 7.2 | | | IB | |
| B1 | | | | | 7.6 | | | MB | |
| [redacted] | | | | | | | | | |
| 133 | 0.864673 | 0.874654 | 0.009981 | | 1198.4 | 1191.4 | 11.94 | ICS | 99.5 |
| 133 | 0.882151 | 0.892334 | 0.010183 | | 1216.4 | 1209.4 | 11.88 | CCS | 99.0 |
| 134 | 0.881184 | 0.891505 | 0.010321 | | 1175.6 | 1168.6 | 11.32 | LCS | 99.9 |
| [redacted] | | | | | | | | | |
| 133 | 0.901715 | 0.912368 | 0.010653 | | 1279.6 | 1272.6 | 11.95 | CCS | |
| [redacted] | | | | | | | | | |

| ANALYST | DATE 3-7-96 | REVIEWED | DATE 3/8/96 | PAGE 1 OF 2 |
|---|---|---|---|---|

REVISED 7/15/95

**HUFFMAN**
LABORATORIES, INC.
*Quality Analytical Services Since 1936*
4630 Indiana Street • Golden, CO 80403

| ANALYSIS : **TOTAL CARBON** | METHOD : HIGH TEMP COMB. - INFRARED DET. |
|---|---|
| INSTRUMENT : LECO CR12 | ANALYZER # 7 |
| BALANCE # 19 | |

| | |
|---|---|
| D. CALCIUM CARBONATE<br>UFFMAN std # 133)<br>12.00 %C (theory) BN 2340 | STD. N.I.S.T. BUFFALO RIVER SEDIMENT 2704<br>(HUFFMAN std # N2704)<br>3.348 %C (theory) BN 4851 |

| SAMPLE # | SAMPLE WT G | | | % CARBON PRE-CALIB | % CARBON POST-CALIB | | QC | % REC. |
|---|---|---|---|---|---|---|---|---|
| [redacted] | | | | | | | | |
| 133 | 0.0980 | | | 12.17 | 11.99 | | ICS | 99.9 |
| 133 | 0.0970 | | | | 11.96 | | CCS | 99.8 |
| [redacted] | | | | | | | | |
| 133 | 0.0990 | | | | 12.06 | | CCS | 100.5 |
| B1 | 1.0000 | | | | 0.003 | | IB | |
| B1 | 1.0000 | | | | 0.008 | | MB | |
| N2704 | 0.2540 | | | | 3.332 | | LCS | 99.5 |
| [redacted] | | | | | | | | |

| LYST [signature] | DATE 3-12-96 | REVIEWED [signature] | DATE 3/12/96 | PAGE 1 OF 3 |
|---|---|---|---|---|

rev 7/3/95

**HUFFMAN LABORATORIES, INC.**
*Quality Analytical Services Since 1936*
4630 Indiana Street • Golden, CO 80403

| | |
|---|---|
| ANALYSIS : **TOTAL CARBON** | METHOD : HIGH TEMP COMB. - INFRARED DET. |
| INSTRUMENT : LECO CR12 | ANALYZER # 7 |
| BALANCE # 19 | |

| | |
|---|---|
| STD. CALCIUM CARBONATE<br>(HUFFMAN std # 133)<br>12.00 %C (theory) BN 2340 | STD. N.I.S.T. BUFFALO RIVER SEDIMENT 2704<br>(HUFFMAN std # N2704)<br>3.348 %C (theory) BN 4851 |

| SAMPLE # | SAMPLE WT G | | | % CARBON PRE-CALIB | % CARBON POST-CALIB | | QC | % REC. |
|---|---|---|---|---|---|---|---|---|
| 133 | 0.1170 | | | | 12.03 | | CCS | 100.3 |
| [redacted] | | | | | | | | |
| 125601 | 0.9900 | | (Entered) | | (1.416) | | MS | |
| 133 | 0.1030 | | Spike | | | | MS | |
| 125601 | 0.9740 | | (Entered) | | (1.413) | | MSD | |
| 133 | 0.1010 | | Spike | | | | MSD | |
| [redacted] | | | | | | | | |
| N2704 | 0.3090 | | | | 3.334 | | CCS | 99.6 |

| | | | | |
|---|---|---|---|---|
| ANALYST<br>[signature] | DATE<br>3-12-96 | REVIEWED<br>[initials] | DATE<br>3/12/96 | PAGE 3 OF 3 |

() indicates instrument Print out

rev 7/3/95

**HUFFMAN**
LABORATORIES, INC.
*Quality Analytical Services Since 1936*
4630 Indiana Street • Golden, CO 80403

| ANALYSIS : **TOTAL CARBON** | METHOD : HIGH TEMP COMB. - INFRARED DET. |
|---|---|
| INSTRUMENT : LECO CR12 | ANALYZER # 7 |
| BALANCE # 19 | |

| D. CALCIUM CARBONATE<br>FFMAN std # 133)<br>2.00 %C (theory) BN 2340 | STD. N.I.S.T. BUFFALO RIVER SEDIMENT 2704<br>(HUFFMAN std # N2704)<br>3.348 %C (theory) BN 4851 |
|---|---|

| SAMPLE # | SAMPLE WT G | | | % CARBON PRE-CALIB | % CARBON POST-CALIB | | QC | % REC. |
|---|---|---|---|---|---|---|---|---|
| [redacted] | | | | | | | | |
| 133 | 0.1070 | | | 12.04 | | | ICS | 100.3 |
| 133 | 0.1180 | | | 11.84 | | | CCS | 98.7 |
| B1 | 1.0000 | | | 0.002 | | | IB | |
| B1 | 1.0000 | | | 0.005 | | | MB | |
| N2704 | 0.3040 | | | 3.329 | | | LCS | 99.4 |
| [redacted] | | | | | | | | |
| 133 | 0.1080 | | | 12.19 | | | CCS | 101.6 |

| ANALYST | DATE 3-4-96 | REVIEWED | DATE 3/12/96 | PAGE 1 OF 2 |
|---|---|---|---|---|

rev 7/3/95

SX: Sucrose Std Theory = 42.10%C bn 3743

**HUFFMAN LABORATORIES, INC.**
*Quality Analytical Services Since 1936*
4630 Indiana Street • Golden, CO 80403

| ANALYSIS : **TOTAL CARBON** | METHOD : HIGH TEMP COMB. - INFRARED DET. |
|---|---|
| INSTRUMENT : LECO CR12 | ANALYZER # 7 |
| BALANCE # 19 | |

| STD. CALCIUM CARBONATE (HUFFMAN std # 133) 12.00 %C (theory) BN 2340 | STD. N.I.S.T. BUFFALO RIVER SEDIMENT 2704 (HUFFMAN std # N2704) 3.348 %C (theory) BN 4851 |
|---|---|

| SAMPLE # | SAMPLE WT G | | | % CARBON PRE-CALIB | % CARBON POST-CALIB | | QC | % REC. |
|---|---|---|---|---|---|---|---|---|
| 125601 | 0.6010 | | WH | 0.205 | | | | |
| 125601 | 0.4870 | | WH | 0.197 | | | DUP | ±2.0% of Mean |
| 125602 | 0.9640 | | WH | 0.032 | | | | |
| [redacted] | | | | | | | | |
| 133 | 0.1190 | | | 12.20 | | | CCS | 101.2 |
| [redacted] | | | | | | | | |
| | | | | | | | | |
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| | | | | | | | | |

| ANALYST | DATE | REVIEWED | DATE | PAGE 2 OF 2 |
|---|---|---|---|---|
| [illegible signature] | 3-4-96 | [illegible signature] | 3/12/96 | |

rev 7/3/95

S# : Sucrose Std Theory = 42.10% C bn 3743

HUFFMAN
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**NON-CLP ANALYSIS RESULTS**
**LABORATORY CONTROL STANDARD**

| | | | |
|---|---|---|---|
| Date: | 03/13/96 | Client: | Evergreen Analytical |
| Lab Name: | Huffman Labs | Contact: | Patty McClellan |
| Contact: | Sue Zeller | Huffman Lab #: | 125696 |

**LABORATORY CONTROL STANDARD**

| Lab ID # | Source | Element/ Compound | True Value | Found Value | % R | Units | Date | Method # | Instrument ID |
|---|---|---|---|---|---|---|---|---|---|
| LCS | BN 4851 | TC | 3.35 | 3.33 | 99 | % | 03/04/96 | Leco CR12 | #7 |
| LCS | BN 4851 | TC | 3.35 | 3.33 | 99 | % | 03/12/96 | Leco CR12 | #7 |
| LCS | BN 2703 | CC | 11.33 | 11.24 | 99 | % | 03/05/96 | COU-02 | #2 |
| LCS | BN 2703 | CC | 11.33 | 11.32 | 100 | % | 03/07/96 | COU-02 | #2 |

**SPIKE RECOVERY**

| Lab ID # | Source | Element/ Compound | True Value | Found Value | % R | Units | Date | Method # | Instrument ID |
|---|---|---|---|---|---|---|---|---|---|
| SPIKE | BN 4712 | TC | 12360 | 11988 | 97 | ug C | 03/12/96 | Leco CR12 | #7 |
| SPIKE DUP | BN 4712 | TC | 12120 | 13662 | 113 | ug C | 03/12/96 | Leco CR12 | #7 |
| SPIKE | BN 4712 | CC | 1377 | 1351 | 98 | ug C | 03/07/96 | COU-02 | #2 |
| SPIKE DUP | BN 4712 | CC | 1357 | 1304 | 96 | ug C | 03/07/96 | COU-02 | #2 |

**HUFFMAN**
**LABORATORIES, INC.**
*Quality Analytical Services Since 1936*
4630 Indiana Street • Golden, CO 80403

## NON-CLP QA/QC ANALYSIS RESULTS
## INITIAL AND CONTINUING CALIBRATION VERIFICATION

| | | | |
|---|---|---|---|
| Date: | 03/13/96 | Client: | Evergreen Analytical |
| Lab Name: | Huffman Labs | Contact: | Patty McClellan |
| Contact: | Sue Zeller | Huffman Lab #: | 125696 |

### INITIAL CALIBRATION

| Lab ID # | Source | Element/ Compound | True Value | Found Value | % R | Units | Date | Method # | Instrument ID |
|---|---|---|---|---|---|---|---|---|---|
| ICS | BN 4712 | TC | 12.00 | 12.04 | 100 | % | 03/04/96 | Leco CR12 | #7 |
| ICS | BN 4712 | TC | 12.00 | 11.99 | 100 | % | 03/12/96 | Leco CR12 | #7 |
| ICS | BN 4712 | CC | 12.00 | 11.96 | 100 | % | 03/05/96 | COU-02 | #2 |
| ICS | BN 4712 | CC | 12.00 | 11.94 | 100 | % | 03/07/96 | COU-02 | #2 |

Slope = NA
Intercept = NA    Single point calibrations for this test.
95% Correlation Coefficient = NA

### CONTINUING CALIBRATION VERIFICATION

| Lab ID # | Source | Element/ Compound | True Value | Found Value | % R | Units | Date | Method # | Instrument ID |
|---|---|---|---|---|---|---|---|---|---|
| CCS | BN 4712 | TC | 12.00 | 12.19 | 102 | % | 03/04/96 | Leco CR12 | #7 |
| CCS | BN 4712 | TC | 12.00 | 12.20 | 102 | % | 03/04/96 | Leco CR12 | #7 |
| CCS | BN 4712 | TC | 12.00 | 12.03 | 100 | % | 03/12/96 | Leco CR12 | #7 |
| CCS | BN 4851 | TC | 3.35 | 3.33 | 99 | % | 03/12/96 | Leco CR12 | #7 |
| CCS | BN 4712 | CC | 12.00 | 11.92 | 99 | % | 03/05/96 | COU-02 | #2 |
| CCS | BN 4712 | CC | 12.00 | 12.01 | 100 | % | 03/05/96 | COU-02 | #2 |
| CCS | BN 4712 | CC | 12.00 | 11.95 | 100 | % | 03/07/96 | COU-02 | #2 |
| CCS | BN 4712 | CC | 12.00 | 11.91 | 99 | % | 03/07/96 | COU-02 | #2 |

# Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 3/1/96 1000 Shipped Via: Fedex
(Airbill # if applicable)

Client : Parsons ES

Client Project ID(s): 722450.14020

EAL Project #(s): 96-0587 EAL Cooler(s): Y N

| | | | | | |
|---|---|---|---|---|---|
| Cooler# | Client | | | | |
| Ice packs | Y N | Y N | Y N | Y N | Y N |
| Temperature °C | 10 | | | | |

| | Y | N | N/A |
|---|---|---|---|
| 1. Custody seal(s) present: | X | | |
| Seals on cooler intact | X | | |
| Seals on bottle intact | | | X |
| 2. Chain of Custody present: | X | | |
| 3. Samples Radioactive: (Comment on COC if >0.5mr/h) | | X | |
| 4. Containers broken or leaking: (Comment on COC if Y) | | X | |
| 5. Containers labeled: | X | | |
| 6. COC agrees w/ bottles received: (Comment on COC if N) | X | | |
| 7. COC agrees w/ labels: (Comment on COC if N) | ✓ | | |
| 8. Headspace in vials-waters only: (Comment on COC if Y) | | | X |
| 9. VOA samples preserved: | | | X |
| 10. pH measured on metals, cyanide or phenolics*: | | | |

List discrepancies

*Non-EAL provided containers only, water samples only.

| | Y | N |
|---|---|---|
| 11. Metal samples present: | | X |
| Total ____, Dissolved ____, TCLP ____ | | |
| D or PD to be filtered: | | |
| T,TR,D,PD to be Preserved: | | |
| 12. Short holding times: | | X |
| Specify parameters | | |
| 13. Multi-phase sample(s) present: | | X |
| 14. COC signed w/ date/time: | X | |

Comments:

(Additional comments on back)

Custodian Signature/Date: PKBlack 3/1/96

**HUFFMAN**
**LABORATORIES, INC.**
*Quality Analytical Services Since 1936*
4630 Indiana Street • Golden, CO 80403

## NON-CLP ANALYSIS RESULTS

| | | | |
|---|---|---|---|
| Date: | 03/13/96 | | |
| Lab Name: | Huffman Labs | Client: | Evergreen Analytical |
| Contact: | Sue Zeller | Contact: | Patty McClellan |
| Sample Matrix: | soil | Huffman Lab #: | 125696 |

| | Client Smp# | Lab ID # | | Element/ Compound | Dilution Factor | Results | | Units | Prep Date | Analysis Date | Sample Size (g) | Method # | Instrument ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BE-MP24-3 | 12569601 | | TC | NA | 0.21 | | % | NA | 03/04/96 | 0.601 | Leco CR12 | #7 |
| | BE-MP24-3 | 12569601 | | TC | NA | 0.20 | | % | NA | 03/04/96 | 0.987 | Leco CR12 | #7 |
| | BE-MP25-7 | 12569602 | | TC | NA | <0.05 | | % | NA | 03/04/96 | 0.964 | Leco CR12 | #7 |
| | BE-MP24-3 | 12569601 | | CC | NA | <0.02 | | % | NA | 03/05/96 | 0.647 | COU-02 | #2 |
| | BE-MP24-3 | 12569601 | | CC | NA | <0.02 | | % | NA | 03/05/96 | 1.027 | COU-02 | #2 |
| | BE-MP25-7 | 12569602 | | CC | NA | <0.02 | | % | NA | 03/05/96 | 0.913 | COU-02 | #2 |
| | | | % moisture | | | | adjusted result | | | | | | |
| X19542 | BE-MP24-3 | 12569601 | 6.58 | TOC | NA | 0.21 | 0.22 | % | NA | NA | NA | by calc | NA |
| X19542 | BE-MP24-3 | 12569601 | 6.58 | TOC | NA | 0.20 | 0.21 | % | NA | NA | NA | by calc | NA |
| X19543 | BE-MP25-7 | 12569602 | 6.62 | TOC | NA | <0.05 | 0.05 | % | NA | NA | NA | by calc | NA |

Samples analyzed and results reported on as as received basis.
Soil samples are not homogeneous.
Values reported below Detection Limits are for reference only.
TC detection limit = 0.05%
CC detection limit = 0.02%
TOC detection limit = 0.05%

# Evergreen Analytical Sample Log Sheet

**Project #** 9~~5~~6-0587

**Date(s) Sampled:** 02/26,28/96 COC

**Date Due:** 03/15/96

**e Received:** 03/01/96 1000

**Holding Time(s):**

**C t Project I.D.** 722450.14020

**Rush** STANDARD

**Client:** PARSONS ENGINEERING SCIENCE, INC.

**Address:** 1301 MARINA VILLAGE PKWY #200
ALAMEDA, CA 94501

**Contact:** MICHAEL PHELPS

**Phone #**510-769-0100 **Fax #**510-769-0100

**Cooler Return** 5.00

**E.A. Cooler #** N/A

**Airbill #** FEDEX 1154092542

**Client P.O.** 722450

**Special Invoicing/Billing**

**Special Instructions**

| Lab ID # | Client ID# | Analysis | Mtx | Btl | Loc |
|---|---|---|---|---|---|
| X19542A | BE-MP24-3 | SIEVE ANALYSIS,TOC | S | TUBE | OUT |
| X19543A | BE-MP25-7 | SIEVE ANALYSIS,TOC | S | TUBE | OUT |

R=Sample to be returned

te GC/MS __ GC __ Metals __ Wet Chem __ HPLC __ SxPrep __

T SxRec C QA/QC C Acctg C File Orig

Page 1 of 1 Page(s)

**Custodian/Date:** [illegible] 3/1/96
[illegible] 3/4/96

# CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

**Evergreen Analytical Inc.**
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

Page 1 of 1

COMPANY Parsons ES
ADDRESS 1301 Marina Village, #200
CITY Alameda STATE CA ZIP 94501
PHONE# 510-769-0100 FAX # 510-769-0100 FAX RESULTS Y / N

CLIENT CONTACT (print) Michael Phelps
PROJECT I.D. 722450.14020
EAL. QUOTE # ______ P.O.# 722450
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day)
☐ Other (Specify) ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature)
(print) Michael Phelps
Evergreen Analytical Cooler No. —
Cooler Received ______

Please **PRINT** all information:

EAL use only
Do not write in shaded area

EAL
Project # 0587
Custodian

| CLIENT SAMPLE IDENTIFICATION | DATE SAMPLED | TIME | No. of Containers | MATRIX: Water-Drinking/Discharge/Ground (circle) | MATRIX: Soil / Solid | MATRIX: Oil / Sludge | TCLP VOA/BNA/Pest/Herb/Metals (circle) | VOA 8260/624/524.2 (circle) | BNA 8270/625 (circle) | Pesticides 8080/608 (circle) | Pest/PCBs 8080/608/508 (circle) | Herbicides 8150/515 (circle) | PCB Screen | BTEX 8020/602 (circle)/MTBE (circle) | TRPH 418.1/Oil & Grease 413.1 (circle) | TVPH 8015mod. (Gasoline) | TEPH 8015mod. (Diesel) | Total Metals-DW / NPDES / SW846 (circle & list metals below) | Dissolved Metals - DW / SW846 (circle & list metals below) | Total Organic Carbon | Grain-size (ASTM) | EAL Sample No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE-MP24-3 | 2/26/96 | 1110 | 1 | | X | | | | | | | | | | | | | | | X | X | X19542A |
| BE-MP25-7 | 2/28/96 | 1040 | 1 | | X | | | | | | | | | | | | | | | X | X | 543 |

HT:
DD:
Location Out
Container Size tube

Instructions:

| Relinqui… …nature) | Date/Time | Received by: (Signature) | …inquished by: (Signature) | Date/Time | Received by: (Sign… | Date/Time |
|---|---|---|---|---|---|---|
| | 2/29/96 1200 | 3/1/96 1000 | | | | |

General Chemistry
There are no quality control anomalies to report for the following analyses: Ammonia by Standard Method 4500-$NH_3$F, Alkalinity by EPA Method 310.1, Total Organic Carbon in water by EPA Method 415.1 or Anions by EPA Method 300.0.

Total Organic Carbon in soil
Total Organic Carbon (TOC) in soil was analyzed by Huffman Laboratories of Golden, Colorado. TOC is determined by analyzing for total carbon (TC) and inorganic (carbonate) carbon (CC), then calculating the difference as TOC. The reports from Huffman are included.

Grain Size
Grain size is determined by sieve analysis as performed by Hazen Research Laboratory of Golden Colorado. The report from Hazen is included. Due to the nature of this report, it is not included on the electronic diskette.

Disk Deliverables
The disk deliverables are included with the hard copy data package. MS/MSD and laboratory duplicate samples are not included on the disk. Please note that blank spaces in the laboratory detection limit and/or practical quantitation limit (PQL) column indicate that there is no detection limit or PQL for that analyte.

Reporting limits have been adjusted to reflect percent moisture content in all soil samples or increases due to dilutions.

A hard copy of each spreadsheet included on the diskette is included. The name for each spreadsheet is located in the top left corner on the first page of each printout.

Patricia A. McClellan

Patricia A. McClellan, Program Manager

Evergreen
Analytical
Laboratory

April 1, 1996

MR MICHAEL PHELPS
PARSONS ENGINEERING SCIENCE INC
1301 MARINA VILLAGE PKWY #200
ALAMEDA, CA 94501

Data Report: 96-0587,0673,0686,0706,
0741,0776,0805
Client Project: 722450.14020 BEALE AFB

Dear Mr. Phelps:

Enclosed are the analytical results for the samples shown in the Sample Log Sheet. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact Patty McClellan, Program Manager.

Upon completion of all required analyses and acceptance of the data report by PES (within 3 weeks of final data package deliver), EAL will be responsible for proper disposal of any remaining samples, sample containers, shipping containers, and Sytrofoam or plastic packing materails in accordance with sound environmental practices, based on the sample analytical results. However, EAL will give prior notification to and receive the approval of PES before disposing of any remaining samples. EAL will maintain proper records of waste disposal methods and disposal methods and disposal company contracts on file for inspection.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

P. McClellan for

Jack Barney
President

JB/mp

Evergreen Analytical, Inc. 4036 Youngfield St. Wheat Ridge, CO 80033-3862 (303) 425-6021 FAX (303) 425-6854

Evergreen Analytical Laboratory

# CASE NARRATIVE

Evergreen Analytical Laboratory (EAL) Projects: 96-0587, 96-0673
96-0686, 96-0706, 96-0741, 96-0776, 96-0805

Parsons Engineering Science, Inc. (PES) Project: Beale AFB
722450.14020

## Sample Receipt
Between March 1 and March 16, 1996, soil and groundwater samples were received at EAL for analysis under subcontract 722450.SC02. Refer to the EAL Check-in Record for specific information regarding the condition of samples upon receipt. Refer to the EAL Sample Log Sheet for specific log-in information and cross-reference of EAL and PES sample identifications.

## Data Package
All data are reported in one comprehensive package that is segregated based upon EAL project number. Each EAL project represents a group of samples received on a given day. The EAL Sample Log Sheet summarizes the samples represented in each EAL project.

A separate invoice for each EAL Project number will be generated.

Quality assurance data may overlap from one EAL project to another. All required matrix spike/matrix spike duplicate (MS/MSD) and laboratory duplicate samples were analyzed when required and also are included in the data package.

## Methane, Method RSKSOP-175
All samples submitted for methane analysis were analyzed within holding time.

The spike recovery in the Laboratory Control Sample LCS031296 was above the acceptance limits of 67 - 85 percent, at 93 percent. This spike recovery is considered to be acceptable.

There are no other quality control anomalies to report.

Analyst: AMP/HCZ Date: 5/21/96 Sequence Name: MAY21 Page 65

Batch No.: 127723 File Prefix: 142JKL Continued from Page: 64

| File No. | Stn. No | Sample Name | Wt/vol | Comment | Std. NO. | Lims No. STD | Name | Vial |
|---|---|---|---|---|---|---|---|---|
| 39 | | 125519-006 | | | | | | |
| 40 | | CCV | | Pass/used | | | | |
| 41 | | CCV | | Pass/used | | | | |
| 42 | | CCV | | Pass/used | | See page | | |
| 43 | | CCV | | | | | | |
| 44 | | CCV | | 8:11 5/22/96 | | | | |

All runs received STD # 1

Calibration on Page 51 BK0719

057

Continued on Page:____

Read and Understood by

5/22/96

5/22/96

Curtis & Tompkins, Ltd.  Sample Batch Report

Batch Number: 27719
Date Started: 21-MAY-96
Batched By : Anna Maria Pajarillo

Analysis : N/A
Bgroup: : TVH
Department: Volatile Organics

| Sample No. | Type | | Client | Matrix | Analysis | Due Date |
|---|---|---|---|---|---|---|
| 125611-001 | | | Burns & McDonnell | Water | TVH | 22-MAY-96 |
| 125615-003 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125616-003 | | | Environmental Science & Engine | Water | TVH | 23-MAY-96 |
| 125616-004 | | | Environmental Science & Engine | Water | TVH | 23-MAY-96 |
| 125628-007 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 23-MAY-96 |
| 125628-008 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 23-MAY-96 |
| QC22221 | LCS | | | Water | | |
| QC22222 | LCS | | | Water | | |
| QC22223 | MB | | | Water | | |
| QC22224 | MS | of 125616-004 | | Water | | |
| QC22225 | MSD | of 125616-004 | | Water | | |

Analyst: AWP Date: 5/20/96 Sequence Name: MAY20 

Batch No.: 27707 File Prefix: 141 TKL Continued from Page 62

| File No. | Stn. No | Sample Name | Wt/vol | Comment | Std. NO. | Lims No. STD Name | Vial |
|---|---|---|---|---|---|---|---|
| 39 | 2 | CCV | 5 | VESS/used | See Previous | | |
| 40 | 5 | | | used 10:02 | Page for | | |
| 41 | 3 | | | | Standards | | |
| | | | | | (p. 62) | | |

Continued on Page:_____

Read and Understood by

055

AWP 5/20/96
Signed Date

CK 5/21/96
Signed Date

Curtis & Tompkins GC04 Run Log Notebook BK0500

Analyst: AMP / HCP Date: 5/21/96 Sequence Name: MAY21 Page 64

Batch No.: 27719 / 27723 File Prefix: 142 IKL Continued from Page:

| File No. | Stn. No | Sample Name | Wt/vol | Comment | Std. NO. | Lims No. STD Name | Vial |
|---|---|---|---|---|---|---|---|
| 1 | 4, 6 | LCS QC22222 | 5ml | Pass 11:22 | 1 | 96WS2466 | A |
| 2 | | MB QC22223 | | | | IS 450 mg/L | |
| 3 | | 125616-004 | | | 2 | 96WS2432 | B |
| 4 | | MS QC22224 | | | | Gas 2000 mg/L | |
| 5 | | MSD QC22225 | | | 3 | 96WS2206 | B |
| 6 | | 125615-003 | | 1:5 | | BTXE 20 mg/L | |
| 7 | | 125611-001 | | 1:2 | 4 | 96WS2427 | |
| 8 | | 125623-007 | | | | BTXE 20 mg/L 2nd | |
| 9 | | 125623-008 | | | 5 | 96WS2123 | |
| 10 | | 125616-003 | | | | JP-4 2000 mg/L | |
| 11 | 2 | CCV | | | 6 | 96WS2036 | |
| 12 | 3, 6 | CCV | 10ml | Pass | | TMB 20 mg/L | |
| 13 | 2 | LCS QC22237 | | Pass | | | |
| 14 | 3 | CCV | | | | | |
| 15 | 4 | LCS QC22238 | | Pass | | | |
| 16 | 5 | CCV | | Pass | | | |
| 17 | | MB QC22239 | | | | | |
| 18 | | 125600-002 | | | | | |
| 19 | 7 | MS QC22240 | | | | | |
| 20 | 4 | MSD QC22241 | | | | | |
| 21 | | 125524-023 | | | | | |
| 22 | | -024 | | | | | |
| 23 | | -025 | | | | | |
| 24 | | -026 | | | | | |
| 25 | | -027 | | | | | |
| 26 | | -028 | | | | | |
| 27 | 2 | CCV | | | | | |
| 28 | 3 | CCV | | | | | |
| 29 | 5 | CCV | | | | | |
| 30 | 2 | CCV | | Pass | | | |
| 31 | 3 | CCV | | Pass | | | |
| 32 | | IB | | | | | |
| 33 | | 125600-001 | | | | | |
| 34 | | 125519-001 | | | | | |
| 35 | | -002 | | | | | |
| 36 | | -003 | | | | | |
| 37 | | -004 | | | | | |
| 38 | | -005 | | | | | |

Continued on Page: 65

Read and Understood by

Curtis & Tompkins, Ltd. Sample Batch Report

Ba  Number: 27666
Da  Started: 18-MAY-96
Batched By : Malinda Ferguson

Analysis : N/A
Bgroup : TVH
Department: Volatile Organics

| Sample No. | Type | | Client | Matrix | Analysis | Due Date |
|---|---|---|---|---|---|---|
| 125496-006 | | | Montgomery Watson | Water | TVH | 20-MAY-96 |
| 125496-007 | | | Montgomery Watson | Water | TVH | 20-MAY-96 |
| 125496-009 | | | Montgomery Watson | Water | TVH | 20-MAY-96 |
| 125558-002 | | | Subsurface Consultants | Water | TVH | 20-MAY-96 |
| 125572-001 | | | Army Corps of Engineers, SPDL | Water | TVH | 24-MAY-96 |
| 125612-001 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-002 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-003 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-004 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-005 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-006 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-007 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-008 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125615-001 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125615-002 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125615-003 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125615-004 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125615-005 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| QC22011 | MB | | | Water | | |
| QC22012 | LCS | | | Water | | |
| QC22013 | LCS | | | Water | | |
| QC22014 | MS | of 125496-009 | | Water | | |
| QC22015 | MSD | of 125496-009 | | Water | | |

Curtis & Tompkins GC04 Run Log Notebook BK0500

Analyst: Anup Date: 5/20/96 Sequence Name: MAY20 Page 62

Batch No.: 27707 File Prefix: 141 JKL Continued from Page:

| File No. | Stn. No | Sample Name | Wt/vol | Comment | Std. NO. | Lims No. STD Name | Vial |
|---|---|---|---|---|---|---|---|
| 1 | 2 | LCS GC22170 | 1g | ~~PASS~~ 12:04 | 1 | 96WS2388 | B |
| 2 | 3 | CCV | 1 | | | IS450 mg/L | |
| 3 | 5 | \| | \| | PASS | 2 | 96WS2432 | B |
| 4 | 3 | ⊥ | \| | PASS / used | | GAS 2000 mg/L | |
| 5 | 4 | LCS GC 22171 | \| | ⊥ Pass/used | 3 | 96WS2206 | B |
| 6 | | MB GC 22172 | \| | ND | | BTXE 20 mg/L | |
| 7 | | MSS 125500-009 | \| | Rerun Surrogate low | 4 | 96WS2427 | B |
| 8 | 2 | MS GC22173 | \| | PASS | | BTXE 20 mg/L | 2° |
| 9 | 2 | MSD GC 22174 | \| | ⊥ | 5 | 96WS2123 | — |
| 10 | | 125500-010 | \| | | | JP-4 2000 | mg/L |
| 11 | | ⊥ -009 | \| | MSS | 6 | 96WS2466 | |
| 12 | | 125465-001 | \| | Over Range Run MeOH | | IS450 mg/L | A |
| 13 | | 1B | ⊥ | Clean-out System | | | |
| 14 | | 125472-001 | 0.5g | Over Range Run MeOH | | | MP 5/20/96 |
| 15 | | 1B | 1g | } clean out | Samples | ~~#~~ | ~~B~~ #1-15 |
| 16 | | 1B | ⊥ | } system | received | Std #1) | |
| 17 | | 125465-001 | 1:25 | MeOH O.R. | All | Samples from | #16+ |
| 18 | | 1B | 1g | | received | Std #6) | |
| 19 | 2 | CCV | \| | | | | |
| 20 | 2 | \| | \| | Pass/used | Initial | Calibration | |
| 21 | 5 | \| | \| | Pass/used | on Page 51 of | | |
| 22 | 3 | \| | \| | Pass/used | BK0419. GC04 | | |
| 23 | 3 | ⊥ | \| | | Run | Log Book. | |
| 24 | | 1B | ⊥ | | | | |
| 25 | | 125465-001 | 1:50 | MeOH | | | |
| 26 | | 1B | 1g | clean system | | | |
| 27 | | 125472-001 | 1:25 | MeOH | | | |
| 28 | | 1B | 1g | clean system | | | |
| 29 | | 125513-032 | \| | | | | |
| 30 | | 125549-015 | \| | | | | |
| 31 | | \| -016 | \| | | | | |
| 32 | | ⊥ -017 | \| | | | | |
| 33 | | 125513-033 | \| | | | | |
| 34 | | 125524-001 | \| | | | | |
| 35 | | \| -002 | \| | | | | |
| 36 | | ⊥ -003 | \| | | | | |
| 37 | | 1B ~~CCV~~ | \| | | | | |
| 38 | 2 | CCV ⊥ | ⊥ | Pass/used 8:57 5/21/96 | | | |

Continued on Page: 63

Read and Understood by

Anup 5/20/96 AK 5/21/96

054

Curtis & Tompkins GC04 Run Log Notebook BK0500

Analyst: CHR/CW Date: 5/20/96 Sequence Name: MAY 18 Page: 58

Batch No.: 27666 File Prefix: 139 Continued from Page:

| File No. | Stn. No | Sample Name | Wt/vol | Comment 5/18/96 1210 | Std. NO. | Lims No. STD Name | Vial |
|---|---|---|---|---|---|---|---|
| 1 | 2 | CCV, QC22012 | 5ml | pass/used | 1 | 96WS2388 | C |
| 2 | 5 | STODD | | used | | IS 450mg/L | |
| 3 | 3,6 | CCV, BX+TMB's | | pass/used | 2 | 96WS2320 | B |
| 4 | 4 | LCS, QC 22013 | | pass/used | | Gas 2000 mg/L | |
| 5 | | MB, QC 22011 | | | 3 | 96WS2206 | B |
| 6 | | 125496-9 | | MSS | | BTXIE 20mg/L | |
| 7 | 2 | MS, QC 22014 | | passed | 4 | 96WS2427 | A |
| 8 | 2 | MSD, QC 22015 | | | | BTXE 20mg/L | 2nd source |
| 9 | | 125572-1 | | | 5 | 95WS1570 | |
| 10 | | 125612-2 | | | | stoddard 2000mg/L | |
| 11 | | -3 | | | 6 | 96WS2036 | |
| 12 | | -4 | | | | TMB 20mg/L | |
| 13 | | -5 | | | | | |
| 14 | 2 | CCV | | passed/used | | | |
| 15 | 3,6 | CCV | | passed/used | | | |
| 16 | 2 | CCV | | | | | |
| 17 | 3,6 | CCV | | | | | |
| 18 | | IB | | | | | |
| 19 | | 125612-6 | | | | | |
| 20 | | -7 | | | | | |
| 21 | | -8 | | | | | |
| 22 | | 125496-6 | | | | | |
| 23 | | -7 | | | | | |
| 24 | | 125615-2 | | | | | |
| 25 | | -3 | | | | | |
| 26 | | -4 | | | | | |
| 27 | | -5 | | | | | |
| 28 | | -1 | | | | | |
| 29 | 2 | CCV | | passed/used | | | |
| 30 | 3.6 | CCV | | | | | |
| 31 | 2 | CCV | | | | | |
| 32 | 3,6 | CCV | | passed/used | | | |
| 33 | | IB | | | | | |
| 34 | | 125612-1 | | | | | |
| 35 | | 125558-2 | 1/50 | | | | |
| 36 | | -1 | 1/100,000 | | | | |
| 37 | 2 | CCV | 5ml | passed/used | | | |
| 38 | 3,6 | CCV | 5ml | | | | |

051

Continued on Page: 57

Read and Understood by

CW — Signed

5/20/96 — Date

Lora Whaling 5-20-96 — Signed Date

Analyst: CHL / CW Date: 5/20/96 Sequence Name: MA918 Page 59

Batch No.: 27666 File Prefix: 139 Continued from Page: 58

| File No. | ~~Str. No~~ std/inj | Sample Name | ~~Wt/vol~~ STD NC | Comment | Std. NO. | Lims No. STD | Name | Vial |
|---|---|---|---|---|---|---|---|---|
| 39 | 5ul | CCV | 2 | | | See previous pg | | |
| 40 | | CCV | 3,6 | passed/used | | | | |
| 41 | | STDDD | 5 | used 5/15/96 | 0829 | | | |
| | | All runs recieved | | STD #1 | | | | |
| | | | | | | | | |
| | | Calibration on Page | | 51 BK0719 | | | | |

Continued on Page:_____

Read and Understood by

Signed: CW Date: 5/20/96

Signed: Lara Whaling Date: 5-20-96

BTXE QA/QC

SEQUENCE FILE: MAY20-21
INSTRUMENT: GC04
BATCH: 27719

MATRIX: WATER
I.C. DATE: 01/26/96
ANALYSIS DATE: 05/21/96

CONTINUING CALIBRATION VERIFICATION: FILE:141K041

| | AMOUNT (ug/L) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| MTBE | 20 | 31.58 | 157.9 | FAIL |
| BENZENE | 20 | 18.8 | 94.0 | PASS |
| TOLUENE | 20 | 19.98 | 99.9 | PASS |
| ETHYL BENZENE | 20 | 19.84 | 99.2 | PASS |
| M,P-XYLENE | 20 | 20.64 | 103.2 | PASS |
| O-XYLENE | 20 | 20.83 | 104.1 | PASS |

TRIFLUOROTOLUENE: 89 PASS BROMOBENZENE: 89 PASS

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LABORATORY CONTROL SAMPLE: FILE:142K001 QC22222

| | AMOUNT (ug/L) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| MTBE | 20 | 26.48 | 132.4 | PASS |
| BENZENE | 20 | 18.08 | 90.4 | PASS |
| TOLUENE | 20 | 19.01 | 95.1 | PASS |
| ETHYL BENZENE | 20 | 18.68 | 93.4 | PASS |
| M,P-XYLENE | 40 | 38.85 | 97.1 | PASS |
| O-XYLENE | 20 | 19.91 | 99.6 | PASS |

TRIFLUOROTOLUENE: 91 PASS BROMOBENZENE: 92 PASS

---

CONTINUING CALIBRATION VERIFICATION: FILE:142K012

| | AMOUNT (ug/L) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| MTBE | 20 | 33.8 | 169.0 | FAIL |
| BENZENE | 20 | 16.91 | 84.6 | PASS |
| TOLUENE | 20 | 19.19 | 96.0 | PASS |
| ETHYL BENZENE | 20 | 17.86 | 89.3 | PASS |
| M,P-XYLENE | 20 | 19.79 | 99.0 | PASS |
| O-XYLENE | 20 | 21.05 | 105.3 | PASS |

TRIFLUOROCTOLUENE: 93 PASS BROMOBENZENE: 92 PASS

---

RECOVERY CCV 85-115% (MTBE 80-120%) TRIFLUOROTOLUENE (58-130%)
LIMITS LCS 80-120% (MTBE 65-135%) BROMOBENZENE (62-131%)
CURTIS & TOMPKINS, LTD

BTXE QA/QC

| | | | |
|---|---|---|---|
| SEQUENCE FILE: | MAY21 | MATRIX: | WATER |
| INSTRUMENT: | GC04 | I.C. DATE: | 01/26/96 |
| BATCH: | 27719 | DATE OF ANALYSIS: | 05/21/96 |

CONTINUING CALIBRATION VERIFICATION: FILE: G:\GC04\142K001

| | AMOUNT (ug/Kg) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| 1,2,3-TMB | 20.0 | 20.1 | 100.4 | PASS |
| 1,2,4-TMB | 20.0 | 19.8 | 98.8 | PASS |
| 1,3,5-TMB | 20.0 | 19.9 | 99.3 | PASS |

TRIFLUOROTOLUENE: 91 PASS BROMOBENZENE: 92 PASS

---

CONTINUING CALIBRATION VERIFICATION: FILE: G:\GC04\142K012

| | AMOUNT (ug/Kg) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| 1,2,3-TMB | 20.0 | 21.9 | 109.5 | PASS |
| 1,2,4-TMB | 20.0 | 22.5 | 112.3 | PASS |
| 1,3,5-TMB | 20.0 | 22.6 | 112.8 | PASS |

TRIFLUOROTOLUENE: 93 PASS BROMOBENZENE: 92 PASS

---

RECOVERY CCV 85-115%
LIMITS 1,2,3-TMB 80-120%
CURTIS & TOMPKINS, LTD

TRIFLUOROTOLUENE (57-131%)
BROMOBENZENE (61-132%)
HCR

BTXE QA/QC

Curtis & Tompkins, Ltd

| | ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| MTBE | 20 | 38.2 | 191.0 | FAIL |
| BENZENE | 20 | 18.4 | 92.0 | PASS |
| TOLUENE | 20 | 19.1 | 95.5 | PASS |
| ETHYL BENZENE | 20 | 19.2 | 96.0 | PASS |
| M,P-XYLENE | 20 | 19.7 | 98.5 | PASS |
| O-XYLENE | 20 | 20.1 | 100.5 | PASS |

TRIFLUOROTOLUENE: 93 PASS BROMOBENZENE: 96 PASS

---

RECOVERY CCV 85-115% (MTBE 80-120%) TRIFLUOROTOLUENE (58-130%)
LIMITS LCS 80-120% (MTBE 65-135%) BROMOBENZENE (62-131%)
CURTIS & TOMPKINS, LTD

BTXE QA/QC

Curtis & Tompkins, Ltd

| | | | |
|---|---|---|---|
| SEQUENCE FILE: | MAY18 | MATRIX: | WATER |
| INSTRUMENT: | GC04 | I.C. DATE: | 01/26/96 |
| BATCH: | 27666 | DATE OF ANALYSIS: | 05/18/96 |

CONTINUING CALIBRATION VERIFICATION: FILE: G:\GC04\139K003

| | AMOUNT (ug/Kg) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| 1,2,3-TMB | 20.0 | 18.6 | 93.0 | PASS |
| 1,2,4-TMB | 20.0 | 18.8 | 93.9 | PASS |
| 1,3,5-TMB | 20.0 | 19.1 | 95.3 | PASS |

TRIFLUOROTOLUENE: 94 PASS BROMOBENZENE: 95 PASS

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CONTINUING CALIBRATION VERIFICATION: FILE: G:\GC04\139K015

| | AMOUNT (ug/Kg) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| 1,2,3-TMB | 20.0 | 18.4 | 92.0 | PASS |
| 1,2,4-TMB | 20.0 | 19.0 | 94.9 | PASS |
| 1,3,5-TMB | 20.0 | 20.2 | 100.9 | PASS |

TRIFLUOROTOLUENE: 95 PASS BROMOBENZENE: 97 PASS

---

CONTINUING CALIBRATION VERIFICATION: FILE: G:\GC04\139K032

| | AMOUNT (ug/Kg) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| 1,2,3-TMB | 20.0 | 19.3 | 96.5 | PASS |
| 1,2,4-TMB | 20.0 | 19.8 | 99.2 | PASS |
| 1,3,5-TMB | 20.0 | 20.9 | 104.6 | PASS |

TRIFLUOROTOLUENE: 94 PASS BROMOBENZENE: 96 PASS

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CONTINUING CALIBRATION VERIFICATION: FILE: G:\GC04\139K040

| | AMOUNT (ug/Kg) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| 1,2,3-TMB | 20.0 | 20.0 | 100.2 | PASS |
| 1,2,4-TMB | 20.0 | 20.2 | 101.0 | PASS |
| 1,3,5-TMB | 20.0 | 21.0 | 105.0 | PASS |

TRIFLUOROTOLUENE: 93 PASS BROMOBENZENE: 96 PASS

---

RECOVERY CCV 85-115%
LIMITS 1,2,3-TMB 80-120%
CURTIS & TOMPKINS, LTD

TRIFLUOROTOLUENE (57-131%)
BROMOBENZENE (61-132%)
HCR

Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 0.00 | 0.00 | ----------- | ----------- | 0 |
| 2 | 12.5000 | 22065.80 | 4676.22 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 49944.10 | 10528.00 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 101038.30 | 21488.12 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 505039.59 | 104463.09 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 815365.13 | 168480.52 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1485334.00 | 303323.59 | ----------- | ----------- | 1 |

Calibration Curve : y = (8397.2979) + (1001.7173)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99785

1,3,5-TMB

Retention Time : 8.280 min Search Window: 2 sec, 2 %
Reference Component: TRIFLUOROTOLUENE (Find Largest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 0.00 | 0.00 | ----------- | ----------- | 0 |
| 2 | 12.5000 | 18122.60 | 3942.51 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 42761.40 | 9114.75 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 91438.99 | 19152.92 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 454541.84 | 93784.82 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 726311.50 | 149146.02 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1360324.63 | 275414.16 | ----------- | ----------- | 1 |

Calibration Curve : y = (3913.8481) + (914.6154)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99890

BTXE QA/QC

Curtis & Tompkins, Ltd

SEQUENCE FILE: MAY18
INSTRUMENT: GC04
BATCH: 27666

MATRIX: WATER
I.C. DATE: 01/26/96
ANALYSIS DATE: 05/18/96

CONTINUING CALIBRATION VERIFICATION: FILE: 139K003

| | AMOUNT (ug/L) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| MTBE | 20 | 36.9 | 184.5 | FAIL |
| BENZENE | 20 | 17.9 | 89.5 | PASS |
| TOLUENE | 20 | 18.5 | 92.5 | PASS |
| ETHYL BENZENE | 20 | 18.4 | 92.0 | PASS |
| M,P-XYLENE | 20 | 18.9 | 94.5 | PASS |
| O-XYLENE | 20 | 19.2 | 96.0 | PASS |

TRIFLUOROTOLUENE: 94 PASS BROMOBENZENE: 95 PASS

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LABORATORY CONTROL SAMPLE: FILE: 139K004 QC22013

| | AMOUNT (ug/L) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| MTBE | 20 | 33.7 | 168.5 | FAIL |
| BENZENE | 20 | 20 | 100.0 | PASS |
| TOLUENE | 20 | 20.3 | 101.5 | PASS |
| ETHYL BENZENE | 20 | 19.8 | 99.0 | PASS |
| M,P-XYLENE | 40 | 40.7 | 101.8 | PASS |
| O-XYLENE | 20 | 20.6 | 103.0 | PASS |

TRIFLUOROTOLUENE: 95 PASS BROMOBENZENE: 94 PASS

---

CONTINUING CALIBRATION VERIFICATION: FILE: 139K015

| | AMOUNT (ug/L) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| MTBE | 20 | 34.5 | 172.5 | FAIL |
| BENZENE | 20 | 17.6 | 88.0 | PASS |
| TOLUENE | 20 | 18.5 | 92.5 | PASS |
| ETHYL BENZENE | 20 | 17.9 | 89.5 | PASS |
| M,P-XYLENE | 20 | 18.7 | 93.5 | PASS |
| O-XYLENE | 20 | 18.9 | 94.5 | PASS |

TRIFLUOROTOLUENE: 95 PASS BROMOBENZENE: 97 PASS

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CONTINUING CALIBRATION VERIFICATION: FILE: 139K032

| | AMOUNT (ug/L) ACTUAL | CALC | % REC | STATUS * |
|---|---|---|---|---|
| MTBE | 20 | 41.9 | 209.5 | FAIL |
| BENZENE | 20 | 19.2 | 96.0 | PASS |
| TOLUENE | 20 | 19.9 | 99.5 | PASS |
| ETHYL BENZENE | 20 | 19.6 | 98.0 | PASS |
| M,P-XYLENE | 20 | 20.3 | 101.5 | PASS |
| O-XYLENE | 20 | 20.7 | 103.5 | PASS |

TRIFLUOROTOLUENE: 94 PASS BROMOBENZENE: 96 PASS

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CONTINUING CALIBRATION VERIFICATION: FILE: 139K040

AMOUNT (ug/L)

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 1934.40 | 430.00 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 12493.00 | 2831.61 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 43688.30 | 9561.35 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 100247.80 | 21566.70 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 472436.91 | 99938.37 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 702088.00 | 149475.34 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1459776.38 | 309126.72 | ----------- | ----------- | 1 |

Calibration Curve : y = (-407.5063) + (959.0111)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99951

BROMOBENZENE
Retention Time : 6.785 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Height versus Amount Using a Pt. to Pt. Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 8 | 2.5000 | 793190.75 | 167400.42 | ----------- | ----------- | 1 |

Sample File : G:\GC04\CONFIRM\CTMB.smp
Created by : on : 5/12/89 2:54 PM
Edited by : on : 5/20/96 2:37 PM
Number Of Times Edited : 0

Initial Calibration Date: ...

CW 5/20/96

**Sample Description :**
Default Injection Volume = 1.0000 ul
An External Standard Calibration Will Be Used
Unknown Peaks Will Be Quantitated Using A Response Factor of 1000000.0000

**Component Information :**

TRIFLUOROTOLUENE
Retention Time : 2.842 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Height versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 8 | 2.5000 | 370592.59 | 78089.03 | ----------- | ----------- | 1 |

Calibration Curve : y = (0.0000) + (0.0000)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.00000

BROMOBENZENE
Retention Time : 6.801 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Height versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 8 | 2.5000 | 1212933.88 | 254237.22 | ----------- | ----------- | 1 |

Calibration Curve : y = (0.0000) + (0.0000)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.00000

1,2,3-TMB
Retention Time : 7.290 min Search Window: 2 sec, 2 %
Reference Component: TRIFLUOROTOLUENE (Find Largest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 7595.00 | 945.18 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 32122.20 | 6113.12 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 69130.00 | 13790.98 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 139994.77 | 28033.53 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 647813.19 | 131498.53 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 1015770.81 | 210788.63 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1867216.88 | 372549.75 | ----------- | ----------- | 1 |

Calibration Curve : y = (18542.1094) + (1252.0919)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99842

044

1,2,4-TMB
Retention Time : 7.750 min Search Window: 2 sec, 2 %
Reference Component: TRIFLUOROTOLUENE (Find Largest Peak)

Sample File : G:\GC04\CONFIRM\CBTXE3.smp
Created by : on : 5/12/89 2:54 PM
Edited by : on : 1/26/96 9:10 AM
Number Of Times Edited : 23

range = 10
intensity = 1

Sample Description :
Default Injection Volume = 1.0000 ul
An External Standard Calibration Will Be Used
Unknown Peaks Will Be Quantitated Using A Response Factor of 1000000.0000

Component Information :

MTBE
Retention Time : 1.154 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Largest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 2 | 12.5000 | 2414.90 | 644.42 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 9064.40 | 2289.76 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 23609.60 | 5872.21 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 116073.31 | 28264.73 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 164030.30 | 39891.57 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 366475.81 | 89698.11 | ----------- | ----------- | 1 |

Calibration Curve : y = (-4055.2905) + (242.4035)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99733

BENZENE
Retention Time : 2.064 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 2895.40 | 784.98 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 18379.90 | 4923.66 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 60970.80 | 15972.84 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 135749.00 | 35185.25 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 611710.63 | 155399.27 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 890909.00 | 227964.16 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1804479.00 | 456285.88 | ----------- | ----------- | 1 |

Calibration Curve : y = (713.3722) + (1207.5815)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99979

TRIFLUOROTOLUENE
Retention Time : 2.824 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Height versus Amount Using a Pt. to Pt. Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 8 | 2.5000 | 301871.81 | 64041.31 | ----------- | ----------- | 1 |

041

TOLUENE

Retention Time : 3.718 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 2721.80 | 673.13 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 15965.00 | 3825.36 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 53769.50 | 12606.48 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 120509.40 | 27888.65 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 558034.13 | 126277.95 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 828766.44 | 188109.39 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1682478.50 | 380409.78 | ----------- | ----------- | 1 |

Calibration Curve : y = (312.3202) + (1118.3734)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99991

ETHYLBENZENE
Retention Time : 5.378 min Search Window: 5 sec, 5 %
Reference Component: BROMOBENZENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 1964.51 | 447.51 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 12842.49 | 2931.25 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 44289.00 | 9898.41 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 100726.29 | 22130.27 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 468847.34 | 101668.99 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 710752.25 | 154158.20 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1446143.63 | 312055.94 | ----------- | ----------- | 1 |

Calibration Curve : y = (-268.4567) + (956.2418)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99982

m,p-XYLENE
Retention Time : 5.526 min Search Window: 5 sec, 5 %
Reference Component: BROMOBENZENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 2762.99 | 636.82 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 16055.68 | 3590.60 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 55524.80 | 11979.87 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 126116.22 | 26609.83 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 583491.13 | 121608.00 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 869212.44 | 183989.94 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1765456.25 | 374175.31 | ----------- | ----------- | 1 |

Calibration Curve : y = (110.2872) + (1172.5034)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99990

o-XYLENE
Retention Time : 5.998 min Search Window: 5 sec, 5 %
Reference Component: BROMOBENZENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

Sample File : G:\GC04\TMB.smp
Created by : on : 5/12/89 2:54 PM
Edited by : on : 5/20/96 2:37 PM
Number Of Times Edited : 0 Initial Calibration Date: 1/26/96

CW 5/20/96

**Sample Description :**
Default Injection Volume = 1.0000 ul
An External Standard Calibration Will Be Used
Unknown Peaks Will Be Quantitated Using A Response Factor of 1000000.0000

**Component Information :**

TRIFLUOROTOLUENE
Retention Time : 2.413 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Height versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 8 | 2.5000 | 344106.19 | 76849.11 | ----------- | ----------- | 1 |

Calibration Curve : y = (0.0000) + (0.0000)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.00000

BROMOBENZENE
Retention Time : 6.162 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Height versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 8 | 2.5000 | 1152127.38 | 239019.05 | ----------- | ----------- | 1 |

Calibration Curve : y = (0.0000) + (0.0000)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.00000

1,2,3-TMB
Retention Time : 6.930 min Search Window: 2 sec, 2 %
Reference Component: TRIFLUOROTOLUENE (Find Largest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 4676.70 | 856.68 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 34262.44 | 6442.38 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 69879.58 | 13413.39 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 133746.56 | 26691.03 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 599672.38 | 124397.88 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 973281.25 | 203010.16 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1709913.00 | 355363.03 | ----------- | ----------- | 1 |

Calibration Curve : y = (23975.0020) + (1151.8377)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99608



1,2,4-TMB
Retention Time : 7.360 min Search Window: 2 sec, 2 %
Reference Component: TRIFLUOROTOLUENE (Find Largest Peak)

Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 3044.20 | 607.84 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 24689.41 | 4804.05 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 49810.80 | 10129.09 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 100136.74 | 20445.47 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 461291.56 | 96790.13 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 744361.63 | 157172.66 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1326502.38 | 279349.44 | ----------- | ----------- | 1 |

Calibration Curve : y = (15042.8486) + (893.4946)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99688

1,3,5-TMB

Retention Time : 7.830 min Search Window: 2 sec, 2 %
Reference Component: TRIFLUOROTOLUENE (Find Largest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 3732.67 | 701.88 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 24769.70 | 4488.30 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 51657.16 | 9212.12 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 94843.96 | 18542.52 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 424592.44 | 87453.02 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 672444.44 | 139600.66 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1215791.50 | 254956.55 | ----------- | ----------- | 1 |

Calibration Curve : y = (16068.7236) + (814.8716)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99774

Retention Time : 3.369 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

Toluene

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 4033.10 | 975.29 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 18550.40 | 4424.93 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 56661.80 | 13289.72 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 122639.10 | 28695.62 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 543820.63 | 128552.16 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 806585.88 | 192251.23 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1652944.88 | 393321.59 | ----------- | ----------- | 1 |

Calibration Curve : y = (2061.5588) + (1094.6157)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99977

ETHYLBENZENE
Retention Time : 5.015 min Search Window: 5 sec, 5 %
Reference Component: BROMOBENZENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 2966.51 | 634.66 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 15320.36 | 3373.62 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 47364.98 | 10348.65 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 102356.15 | 22432.36 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 460443.63 | 101715.31 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 696296.38 | 154284.42 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1417643.38 | 314905.75 | ----------- | ----------- | 1 |

Calibration Curve : y = (1190.6255) + (937.9269)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99981

m,p-XYLENE
Retention Time : 5.169 min Search Window: 5 sec, 5 %
Reference Component: BROMOBENZENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 4333.96 | 915.03 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 19232.25 | 4096.34 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 58617.82 | 12277.18 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 126606.71 | 26623.63 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 563235.31 | 120459.57 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 836746.75 | 182632.80 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1700683.75 | 374762.63 | ----------- | ----------- | 1 |

Calibration Curve : y = (2291.4168) + (1129.8170)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99986

o-XYLENE
Retention Time : 5.578 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x

0-xylene

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 2662.90 | 611.05 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 14951.30 | 3187.77 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 46354.30 | 9738.74 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 100849.13 | 21364.83 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 455173.00 | 97308.00 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 670957.81 | 145525.41 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1383192.13 | 300450.78 | ----------- | ----------- | 1 |

Calibration Curve : y = (1010.3149) + (914.9463)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99971

BROMOBENZENE
Retention Time : 6.166 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Height versus Amount Using a Pt. to Pt. Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 8 | 2.5000 | 787998.31 | 166316.73 | ----------- | ----------- | 1 |

Curtis & Tompkins, Ltd.

Lab #: 125615 BATCH QC REPORT 

## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 27719
Units: ug/L
Diln Fac: 1

Prep Date: 05/21/96
Analysis Date: 05/21/96

LCS Lab ID: QC22222

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 18.08 | 20 | 90 | 80-120 |
| Toluene | 19.01 | 20 | 95 | 80-120 |
| Ethylbenzene | 18.68 | 20 | 93 | 80-120 |
| m,p-Xylenes | 38.85 | 40 | 97 | 80-120 |
| o-Xylene | 19.91 | 20 | 100 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 91 | 58-130 |
| Bromobenzene | 92 | 62-131 |

Column to be used to flag recovery and RPD values with an asterisk
Values outside of QC limits
ike Recovery: 0 out of 5 outside limits

Sample File : G:\GC04\BTXE3.smp
Created by : on : 5/12/89 2:54 PM
Edited by : on : 1/26/96 9:09 AM
Number Of Times Edited : 63

range = 2
intensity = 1

**Sample Description** :
Default Injection Volume = 1.0000 ul
An External Standard Calibration Will Be Used
Unknown Peaks Will Be Quantitated Using A Response Factor of 1000000.0000

**Component Information** :

MTBE

Retention Time : 1.114 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Largest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 2 | 12.5000 | 4020.66 | 989.61 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 11330.50 | 2794.52 | ----------- | ----------- | 1 |
| 4 | 100.4000 | 25637.00 | 6483.12 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 116573.10 | 28895.31 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 160983.00 | 40867.60 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 356797.59 | 91765.27 | ----------- | ----------- | 1 |

Calibration Curve : y = (-1295.3915) + (234.5134)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99734

BENZENE

Retention Time : 1.815 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Area versus Amount Using a 1st Order Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1/x
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 1 | 2.5000 | 4039.30 | 1226.65 | ----------- | ----------- | 1 |
| 2 | 12.5000 | 20863.00 | 6227.44 | ----------- | ----------- | 1 |
| 3 | 50.0000 | 62341.00 | 18491.67 | ----------- | ----------- | 1 |
| 4 | 100.0000 | 135119.70 | 40068.50 | ----------- | ----------- | 1 |
| 5 | 500.0000 | 596198.13 | 178782.27 | ----------- | ----------- | 1 |
| 6 | 750.0000 | 882501.81 | 265308.38 | ----------- | ----------- | 1 |
| 7 | 1500.0000 | 1801279.88 | 541700.50 | ----------- | ----------- | 1 |

Calibration Curve : y = (2096.3135) + (1196.4558)x + (0.0000)x^2 + (0.0000)x^3
Correlation Coefficient: 0.99981

TRIFLUOROTOLUENE

Retention Time : 2.411 min Search Window: 5 sec, 5 %
Reference Component: TRIFLUOROTOLUENE (Find Closest Peak)
Group Name :
Calibrating Height versus Amount Using a Pt. to Pt. Fit
Amounts Will Not Be Scaled Prior To The Regression
Weighting Factor For the Regression: 1
Calibration Levels:

| Level Name | Amount | Area | Height | ISTD Resp. | ISTD Amt. | # Replicates |
|---|---|---|---|---|---|---|
| 8 | 2.5000 | 294475.19 | 66228.97 | ----------- | ----------- | 1 |



TOLUENE

Curtis & Tompkins, Ltd.

Lab #: 125615 BATCH QC REPORT 

| BTXE | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: EPA 8020<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Water<br>Batch#: 27719<br>Units: ug/L<br>Diln Fac: 1 | Prep Date: 05/21/96<br>Analysis Date: 05/21/96 |

MB Lab ID: QC22223

| Analyte | Result | |
|---|---|---|
| Benzene | <0.5 | |
| Toluene | <0.5 | |
| Ethylbenzene | <0.5 | |
| m,p-Xylenes | <0.5 | |
| o-Xylene | <0.5 | |
| 1,2,3-Trimethylbenzene | <0.5 | |
| 1,2,4-Trimethylbenzene | <0.5 | |
| 1,3,5-Trimethylbenzene | <0.5 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 88 | 58-130 |
| Bromobenzene | 87 | 62-131 |

Curtis & Tompkins, Ltd



BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Water | Prep Date: 05/18/96 |
| Batch#: 27666 | Analysis Date: 05/18/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

LCS Lab ID: QC22013

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 20 | 20 | 100 | 80-120 |
| Toluene | 20.3 | 20 | 102 | 80-120 |
| Ethylbenzene | 19.8 | 20 | 99 | 80-120 |
| m,p-Xylenes | 40.7 | 40 | 102 | 80-120 |
| o-Xylene | 20.6 | 20 | 103 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 95 | 58-130 |
| Bromobenzene | 94 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

## BTXE

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: EPA 8020 |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 125615-005 | TRIP BLANK | 27666 | 05/15/96 | 05/19/96 | 05/19/96 | |

Matrix: Water

| Analyte<br>Diln Fac: | Units | 125615-005<br>1 |
|---|---|---|
| Benzene | ug/L | <0.5 |
| Toluene | ug/L | <0.5 |
| Ethylbenzene | ug/L | <0.5 |
| m,p-Xylenes | ug/L | <0.5 |
| o-Xylene | ug/L | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 |
| **Surrogate** | | |
| Trifluorotoluene | %REC | 95 |
| Bromobenzene | %REC | 97 |

Curtis & Tompkins, Ltd

Lab #: 125615

BATCH QC REPORT



BTXE

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

METHOD BLANK

| | | | |
|---|---|---|---|
| Matrix: | Water | Prep Date: | 05/18/96 |
| Batch#: | 27666 | Analysis Date: | 05/18/96 |
| Units: | ug/L | | |
| Diln Fac: | 1 | | |

MB Lab ID: QC22011

| Analyte | Result |
|---|---|
| Benzene | <0.5 |
| Toluene | <0.5 |
| Ethylbenzene | <0.5 |
| m,p-Xylenes | <0.5 |
| o-Xylene | <0.5 |
| 1,2,3-Trimethylbenzene | <0.5 |
| 1,2,4-Trimethylbenzene | <0.5 |
| 1,3,5-Trimethylbenzene | <0.5 |

| Surrogate | %Rec | Recovery Limits |
|---|---|---|
| Trifluorotoluene | 96 | 58-130 |
| Bromobenzene | 95 | 62-131 |

Curtis & Tompkins, Ltd.

# BTXE Data

## BTXE

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 125615-001 | BE-MP10-01 | 27666 | 05/14/96 | 05/19/96 | 05/19/96 | |
| 125615-002 | BE-MP12-01 | 27666 | 05/15/96 | 05/19/96 | 05/19/96 | |
| 125615-003 | BE-MP13-01 | 27719 | 05/14/96 | 05/21/96 | 05/21/96 | |
| 125615-004 | BE-MP47-01 | 27666 | 05/14/96 | 05/19/96 | 05/19/96 | |

Matrix: Water

| Analyte | Units | 125615-001 | 125615-002 | 125615-003 | 125615-004 |
|---|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | 5 | 1 |
| Benzene | ug/L | <0.5 | <0.5 | <2.5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 | 9.2 | <0.5 |
| Ethylbenzene | ug/L | 20 | <0.5 | 22 | <0.5 |
| m,p-Xylenes | ug/L | 19 | <0.5 | 35 | <0.5 |
| o-Xylene | ug/L | 2.9 | <0.5 | 4.9 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 | 120 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | 3.6 | <0.5 | <2.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | 7.8 | <0.5 | 59 | <0.5 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 113 | 93 | 119 | 95 |
| Bromobenzene | %REC | 106 | 94 | 91 | 98 |

Analyst: AMP/HCR Date: 5/21/96 Sequence Name: MAY21 Page 65

Batch No.: 127723 File Prefix: 142JKL Continued from Page: 64

| File No. | Stn. No | Sample Name | Wt/vol | Comment | Std. NO. | Lims No. STD | Name | Vial |
|---|---|---|---|---|---|---|---|---|
| 39 | | 125519-006 | | | | | | |
| 40 | | CCV | | Pass/used | | | previous | |
| 41 | | CCV | | Pass/used | | | for | |
| 42 | | CCV | | Pass/used | See | page | stds | |
| 43 | | CCV | | | | | | |
| 44 | | CCV | | 8:11 5/22/96 | | | | |

All runs received std #1
Calibration on Page 51 BK0719

027

Continued on Page:____

Read and Understood by

5/22/96 5/22/96

Curtis & Tompkins, Ltd. Sample Batch Report

Batch Number: 27719
Date Started: 21-MAY-96
Batched By : Anna Maria Pajarillo

Analysis : N/A
Bgroup: : TVH
Department: Volatile Organics

| Sample No. | Type | | Client | Matrix | Analysis | Due Date |
|---|---|---|---|---|---|---|
| 125611-001 | | | Burns & McDonnell | Water | TVH | 22-MAY-96 |
| 125615-003 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125616-003 | | | Environmental Science & Engine | Water | TVH | 23-MAY-96 |
| 125616-004 | | | Environmental Science & Engine | Water | TVH | 23-MAY-96 |
| 125628-007 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 23-MAY-96 |
| 125628-008 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 23-MAY-96 |
| QC22221 | LCS | | | Water | | |
| QC22222 | LCS | | | Water | | |
| QC22223 | MB | | | Water | | |
| QC22224 | MS | of 125616-004 | | Water | | |
| QC22225 | MSD | of 125616-004 | | Water | | |

Analyst: AMP Date: 5/20/96 Sequence Name: MAY20 Page 63

Batch No.: 27707 File Prefix: 141 TKL Continued from Page 62

| File No. | Stn. No | Sample Name | Wt/vol | Comment | Std. NO. | Lims No. STD | Name | Vial |
|---|---|---|---|---|---|---|---|---|
| 39 | 2 | CCV | 5 | 11:53 / used | See Previous | | | |
| 40 | 5 | \| | \| | \| / used 10:02 | Page for | | | |
| 41 | 3 | ↓ | ↓ | ↓ | Standards (p. 62) | | | |
| | | | | | | | | |
| | | | | | | | | |

Continued on Page:

Signed AMP Date 5/20/96

Read and Understood by

Signed [illegible] Date 5/21/96

Analyst: AMP / HCP Date: 5/21/96 Sequence Name: MAY21 Page 64

Batch No.: 27719/27723 File Prefix: 142 IKL Continued from Page:

| File No. | Stn. No | Sample Name | Wt/vol | Comment | Std. NO. | Lims No. STD Name | Vial |
|---|---|---|---|---|---|---|---|
| 1 | 4,6 | LCS QC22222 | 5ml | Pass 11:22 | 1 | 96WS2466 | A |
| 2 | | MB QC22223 | | | | IS 450 mg/L | |
| 3 | | 125616-004 | | | 2 | 96WS 1432 | B |
| 4 | | MS QC22224 | | | | Gas 2000 mg/L | |
| 5 | | MSD QC22225 | | | 3 | 96WS2206 | B |
| 6 | | 125615-003 | | 1:5 | | BTXE 20 mg/L | |
| 7 | | 125611-001 | | 1:2 | 4 | 96WS2427 | |
| 8 | | 125622-007 | | | | BTXE 20 mg/L 2nd | |
| 9 | | 125622-008 | | | 5 | 96WS2123 | |
| 10 | | 125616-003 | | | | JP-4 2000 mg/L | |
| 11 | 2 | CCV | | | 6 | 96WS2036 | |
| 12 | 3,6 | CCV | 1ul | Pass | | TMB 20 mg/L | |
| 13 | 2 | LCS QC22237 | | Pass | | | |
| 14 | 3 | CCV | | | | | |
| 15 | 4 | LCS QC22238 | | Pass | | | |
| 16 | 5 | CCV | | Pass | | | |
| 17 | | MB QC22239 | | | | | |
| 18 | | 125600-002 | | | | | |
| 19 | 4 | MS QC22240 | | | | | |
| 20 | 4 | MSD QC22241 | | | | | |
| 21 | | 125524-023 | | | | | |
| 22 | | -024 | | | | | |
| 23 | | -025 | | | | | |
| 24 | | -026 | | | | | |
| 25 | | -027 | | | | | |
| 26 | | -028 | | | | | |
| 27 | 2 | CCV | | | | | |
| 28 | 3 | CCV | | | | | |
| 29 | 5 | CCV | | | | | |
| 30 | 2 | CCV | | Pass | | | |
| 31 | 3 | CCV | | Pass | | | |
| 32 | | IB | | | | | |
| 33 | | 125600-001 | | | | | |
| 34 | | 125519-001 | | | | | |
| 35 | | -002 | | | | | |
| 36 | | -003 | | | | | |
| 37 | | -004 | | | | | |
| 38 | | -005 | | | | | |

Continued on Page: 65

Read and Understood by

AMP 5/22/96 RA 5/22/96

02

Curtis & Tompkins, Ltd. Sample Batch Report

Ba[illegible]ch Number: 27666
[illegible] Started: 18-MAY-96
B[illegible]ched By : Malinda Ferguson

Analysis : N/A
Bgroup: : TVH
Department: Volatile Organics

| Sample No. | Type | | Client | Matrix | Analysis | Due Date |
|---|---|---|---|---|---|---|
| 125496-006 | | | Montgomery Watson | Water | TVH | 20-MAY-96 |
| 125496-007 | | | Montgomery Watson | Water | TVH | 20-MAY-96 |
| 125496-009 | | | Montgomery Watson | Water | TVH | 20-MAY-96 |
| 125558-002 | | | Subsurface Consultants | Water | TVH | 20-MAY-96 |
| 125572-001 | | | Army Corps of Engineers, SPDL | Water | TVH | 24-MAY-96 |
| 125612-001 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-002 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-003 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-004 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-005 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-006 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-007 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125612-008 | | | Burns & McDonnell | Water | TVH | 20-MAY-96 |
| 125615-001 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125615-002 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125615-003 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125615-004 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| 125615-005 | | | Parsons Engineering Science, I | Water | TVH/BTXE | 22-MAY-96 |
| QC22011 | MB | | | Water | | |
| QC22012 | LCS | | | Water | | |
| QC22013 | LCS | | | Water | | |
| QC22014 | MS | of 125496-009 | | Water | | |
| QC22015 | MSD | of 125496-009 | | Water | | |

Curtis & Tompkins GC04 Run Log Notebook BK0500

Analyst: Anup Date: 5/20/96 Sequence Name: MAY20 Page 62

Batch No.: 27707 File Prefix: 141 JKL Continued from Page:

| File No. | Stn. No | Sample Name | Wt/vol | Comment | Std. NO. | Lims No. STD Name | Vial |
|---|---|---|---|---|---|---|---|
| 1 | 2 | LCS QC22170 | 1g | ~~PASS~~ 12:04 | 1 | 96WS2388 | B |
| 2 | 3 | CCV | \| | | | IS450 ug/L | |
| 3 | 5 | \| | \| | PASS | 2 | 96WS2432 | B |
| 4 | 3 | ⊥ | | PASS / used | | GAS 2000 ug/L | |
| 5 | 4 | LCS QC22171 | | ⊥ Pass/used | 3 | 96WS2206 | B |
| 6 | | MB QC22172 | | ND | | BTXE 20 ug/L | |
| 7 | | MSS 125500-009 | | Return Surrogate Low | 4 | 96WS2427 | B |
| 8 | 2 | MS QC22173 | | PASS | | BTXE 20 ug/L | 2° |
| 9 | 2 | MSD QC22174 | | ⊥ | 5 | 96WS2123 | — |
| 10 | | 125500-010 | | | | JP-4 2,000 | ug/L |
| 11 | | ⊥ -009 | | MSS | 6 | 96WS2466 | |
| 12 | | 125465-001 | | OverRange Run MeOH | | IS450 ug/L | A |
| 13 | | IB | ⊥ | Clean-out System | | | |
| 14 | | 125472-001 | 0.5g | OverRange Run MeOH | | | anp 5/20/96 |
| 15 | | IB | 1g | Clean out | Samples ~~#7-15~~ | | #1-5 |
| 16 | | IB | ⊥ | system | received std #(1) | | |
| 17 | | 125465-001 | 1:25 | MeOH O.R. | All Samples from | | #16+ |
| 18 | | IB | 1g | | received std #(6) | | |
| 19 | 2 | CCV | \| | | | | |
| 20 | 2 | \| | \| | Pass/used | Initial Calibration | | |
| 21 | 5 | \| | \| | Pass/used | on page 51 of | | |
| 22 | 3 | \| | \| | Pass/used | BK 0719 GC04 | | |
| 23 | 3 | ⊥ | \| | | Run Log Book | | |
| 24 | | IB | ⊥ | | | | |
| 25 | | 125465-001 | 1:50 | MeOH | | | |
| 26 | | IB | 1g | Clean system | | | |
| 27 | | 125472-001 | 1:25 | MeOH | | | |
| 28 | | IB | 1g | Clean system | | | |
| 29 | | 125513-032 | 1 | | | | |
| 30 | | 125549-015 | \| | | | | |
| 31 | | \| -016 | \| | | | | |
| 32 | | ⊥ -017 | \| | | | | |
| 33 | | 125513-033 | \| | | | | |
| 34 | | 125524-001 | \| | | | | |
| 35 | | \| -002 | \| | | | | |
| 36 | | ⊥ -003 | \| | | | | |
| 37 | | IB ~~CCV~~ | \| | | | | |
| 38 | 2 | CCV ⊥ | ⊥ | Pass/used 8:37 5/21/96 | | | |

Continued on Page: 63

Read and Understood by

Signed: Anup Date: 5/20/96 Signed: [signature] Date: 5/21/96

02

Analyst: CH/CW Date: 5/20/96 Sequence Name: MAY 18 Page: 58

Batch No.: 27666 File Prefix: 139 Continued from Page:

| File No. | Stn. No | Sample Name | Wt/vol | Comment 5/18/96 1210 | Std. NO. | Lims No. STD Name | Vial |
|---|---|---|---|---|---|---|---|
| 1 | 2 | CCV, QC22012 | 5ml | pass/used | 1 | 96WS2388 | C |
| 2 | 5 | STDOD | | used | | IS 450ug/L | - |
| 3 | 3,6 | CCV, BX+TMB's | | pass/used | 2 | 96WS2320 | B |
| 4 | 4 | LCS, QC22013 | | pass/used | | Gas 2000ug/L | |
| 5 | | MB, QC22011 | | | 3 | 96WS2206 | B |
| 6 | | 125496-9 | | MSS | | BTXE 20ug/L | |
| 7 | 2 | MS, QC22014 | | passed | 4 | 96WS2427 | A |
| 8 | 2 | MSD, QC22015 | | | | BTXE 20ug/L | 2nd source |
| 9 | | 125572-1 | | | 5 | 95WS1590 | |
| 10 | | 125612-2 | | | | standard 2000ug/L | |
| 11 | | -3 | | | 6 | 96WS2036 | |
| 12 | | -4 | | | | TMB 20ug/L | |
| 13 | | -5 | | | | | |
| 14 | 2 | CCV | | passed/used | | | |
| 15 | 3,6 | CCV | | passed/used | | | |
| 16 | 2 | CCV | | | | | |
| 17 | 3,6 | CCV | | | | | |
| 18 | | IB | | | | | |
| 19 | | 125612-6 | | | | | |
| 20 | | -7 | | | | | |
| 21 | | -8 | | | | | |
| 22 | | 125496-6 | | | | | |
| 23 | | -7 | | | | | |
| 24 | | 125615-2 | | | | | |
| 25 | | -3 | | | | | |
| 26 | | -4 | | | | | |
| 27 | | -5 | | | | | |
| 28 | | -1 | | | | | |
| 29 | 2 | CCV | | passed/used | | | |
| 30 | 3,6 | CCV | | | | | |
| 31 | 2 | CCV | | | | | |
| 32 | 3,6 | CCV | | passed/used | | | |
| 33 | | IB | | | | | |
| 34 | | 125612-1 | | | | | |
| 35 | | 125558-2 | 1/50 | | | | |
| 36 | | -1 | 1/100,000 | | | | |
| 37 | 2 | CCV | 5ml | passed/used | | | |
| 38 | 3,6 | CCV | 5ml | | | | |

Continued on Page: 59

021

Read and Understood by

CW
Signed

5/20/96
Date

5-20-96
Signed Date

Analyst: CHL / CW Date: 5/20/96 Sequence Name: MA0!8 Page 59

Batch No.: 27666 File Prefix: 139 Continued from Page: 58

| File No. | ~~Stn.~~ wt/vol ~~No~~ | Sample Name | ~~Wt/vol~~ STD NO | Comment | Std. NO. | Lims No. STD | Name | Vial |
|---|---|---|---|---|---|---|---|---|
| 39 | Soil | CCV | 2 | | See previous pg | | | |
| 40 | | CCV | 3,6 | passed/used | | | | |
| 41 | | STDDD | 5 | used 5/15/96 | 0829 | | | |
| | | all runs recieved | | STD #1 | | | | |
| | | | | | | | | |
| | | Calibration on Page | | 51 BK0719 | | | | |

Continued on Page:____

Read and Understood by

CW 5/20/96 Lara Whaling 5-20-96

Signed Date Signed Date

02

Curtis & Tompkins, Ltd

CURTIS & TOMPKINS, LTD

BROMOBENZENE (BB): 70-122 %

INSTRUMENT: GC04
SEQUENCE: MAY20-21
I.C.DATE: 01/25/96

DATE OF INJECTION21-MAY-96
MATRIX: WATER
BATCH: 27719

LABORATORY CONTROL SAMPLE: RESULT FILE: G:\GC04\141J038
QC22221

| AMOUNT (ug/L) | ACTUAL | CALC | % REC | STATUS |
|---|---|---|---|---|
| LUFT | 2000 | 1802 | 90.1% | IN COMPLIANCE |

SURROGATES, %REC : TFT = 92 PASS BB = 94 PASS

---

CONTINUING CALIBRATION CHECK: RESULT FILE: G:\GC04\142J013

| AMOUNT (ug/L) | ACTUAL | CALC | % REC | STATUS |
|---|---|---|---|---|
| LUFT | 2000 | 1926.99 | 96.3% | IN COMPLIANCE |

SURROGATES, %REC : TFT = 95 PASS BB = 95 PASS

---

MSS sample: 125616-004 FILE 142J003
LUFT (ug/L) 0

SURROGATES, %REC : TFT = 84 PASS BB = 86 PASS

---

| MATRIX SPIKE: | ACTUAL | CALC | % REC | STATUS | 142J004 |
|---|---|---|---|---|---|
| LUFT (ug/L) | 2000 | 1796.42 | 89.8% | IN COMPLIANCE | QC22224 |

SURROGATES, %REC : TFT = 91 PASS BB = 96 PASS

---

| MATRIX SPIKE DUP: | ACTUAL | CALC | % REC | STATUS | FILE 142J005 |
|---|---|---|---|---|---|
| LUFT (ug/L) | 2000 | 1666.96 | 83.3% | IN COMPLIANCE | QC22225 |

SURROGATES, %REC : TFT = 77 PASS BB = 82 PASS

---

AVERAGE SPIKE RECOVERY:
LUFT 86.6% RPD: 7.5 IN COMPLIANCE

RECOVERY LIMITS CCV/LCS LUFT +/-10% DIFF MS/MSD LUFT +/-25% DIFF
SURROGATES TRIFLUOROTOLUENE (TFT): 69-120 %
BROMOBENZENE (BB): 70-122 %

CURTIS & TOMPKINS, LTD

QA/QC FOR TVH (GASOLINE) ANALYSIS BY P&T Curtis & Tompkins, Ltd

TVH GASOLINE BY P&T GC/FID CALIBRATION FOR WATER/SOIL
GC04 LUFT
CALIBRATION DATE: JANUARY 25, 1996 SEQUENCE: JAN25

| AMOUNT (ng) | SAMPLE AREA | FILE | Y CALC | RESIDUAL |
|---|---|---|---|---|
| 500 | 618586.5 | 025J004 | 672.3 | 172.3 |
| 2500 | 2511783.8 | 025J005 | 2296.4 | -203.6 |
| 5000 | 5551755 | 025J006 | 4904.1 | -95.9 |
| 10000 | 11680494 | 025J007 | 10161.5 | 161.5 |
| 15000 | 17316556 | 025J008 | 14996.2 | -3.8 |
| 25000 | 28942862 | 025J009 | 24969.5 | -30.5 |

Regression Output:

| | |
|---|---|
| Constant | 141.7110809 |
| Std Err of Y Est | 163.8457844 |
| R Squared | 0.999744835 |
| No. of Observations | 6 |
| Degrees of Freedom | 4 |

| | |
|---|---|
| X Coefficient(s) | 0.00085782 |
| Std Err of Coef. | 0.00000685 |

RANGE = 0

Curtis & Tompkins, Ltd

INSTRUMENT: GC04
SEQUENCE: MAY18
I.C.DATE: 01/25/96

DATE OF INJECTION18-MAY-
MATRIX: WATER
BATCH: 27666

LABORATORY CONTROL SAMPLE: RESULT FILE: G:\GC04\139J001
QC22012

| AMOUNT (ug/L) | ACTUAL | CALC | % REC | STATUS |
|---|---|---|---|---|
| LUFT | 2000 | 2004.89 | 100.2% | IN COMPLIANCE |

SURROGATES, %REC : TFT = 100 PASS BB = 100 PASS

---

CONTINUING CALIBRATION CHECK: RESULT FILE: G:\GC04\139J014

| AMOUNT (ug/L) | ACTUAL | CALC | % REC | STATUS |
|---|---|---|---|---|
| LUFT | 2000 | 1886.72 | 94.3% | IN COMPLIANCE |

SURROGATES, %REC : TFT = 105 PASS BB = 105 PASS

---

CONTINUING CALIBRATION CHECK: RESULT FILE: G:\GC04\139J029

| AMOUNT (ug/L) | ACTUAL | CALC | % REC | STATUS |
|---|---|---|---|---|
| LUFT | 2000 | 1986.48 | 99.3% | IN COMPLIANCE |

SURROGATES, %REC : TFT = 106 PASS BB = 106 PASS

---

CONTINUING CALIBRATION CHECK: RESULT FILE: G:\GC04\139J037

| AMOUNT (ug/L) | ACTUAL | CALC | % REC | STATUS |
|---|---|---|---|---|
| LUFT | 2000 | 1976.44 | 98.8% | IN COMPLIANCE |

SURROGATES, %REC : TFT = 106 PASS BB = 108 PASS

---

MSS sample: 125496-009 FILE 139J006
LUFT (ug/L) 0

SURROGATES, %REC : TFT = 92 PASS BB = 92 PASS

---

| MATRIX SPIKE: | ACTUAL | CALC | % REC | STATUS | 139J007 |
|---|---|---|---|---|---|
| LUFT (ug/L) | 2000 | 2074.57 | 103.7% | IN COMPLIANCE | QC22014 |

SURROGATES, %REC : TFT = 104 PASS BB = 103 PASS

---

| MATRIX SPIKE DUP: | ACTUAL | CALC | % REC | STATUS | FILE 139J008 |
|---|---|---|---|---|---|
| LUFT (ug/L) | 2000 | 2069.11 | 103.5% | IN COMPLIANCE | QC22015 |

SURROGATES, %REC : TFT = 105 PASS BB = 105 PASS

---

AVERAGE SPIKE RECOVERY:
LUFT 103.6% RPD: 0.3 IN COMPLIANCE

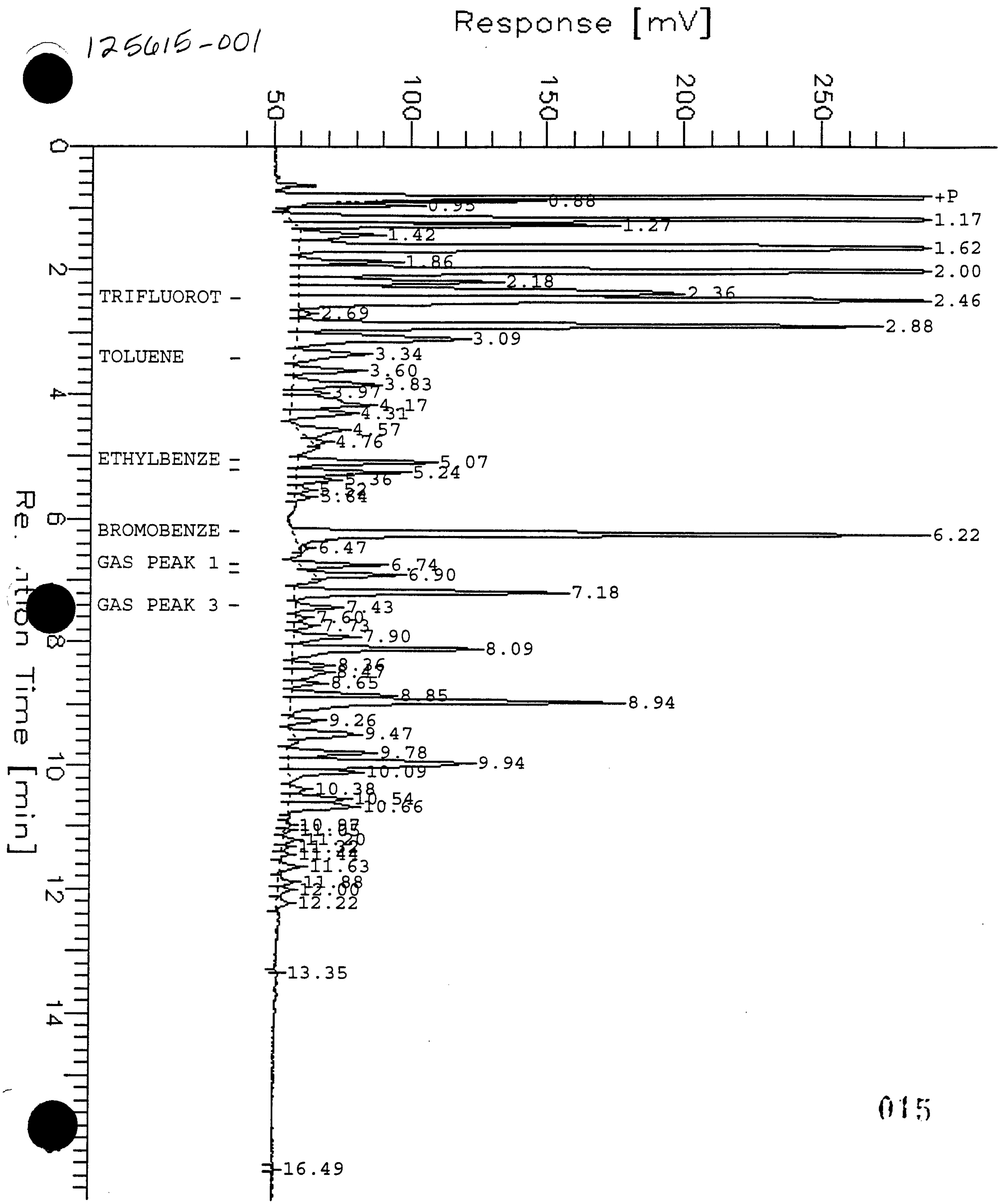
RECOVERY LIMITS CCV/LCS LUFT +/-10% DIFF MS/MSD LUFT +/-25% DIFF

SURROGATES TRIFLUOROTOLUENE (TFT): 69-120 %

FileName : G:\GC04\139J028.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 17.00 min
Plot Offset: 38 mV
Date : 5/19/96 2:39 AM
Low Point : 37.62 mV
Plot Scale: 250 mV

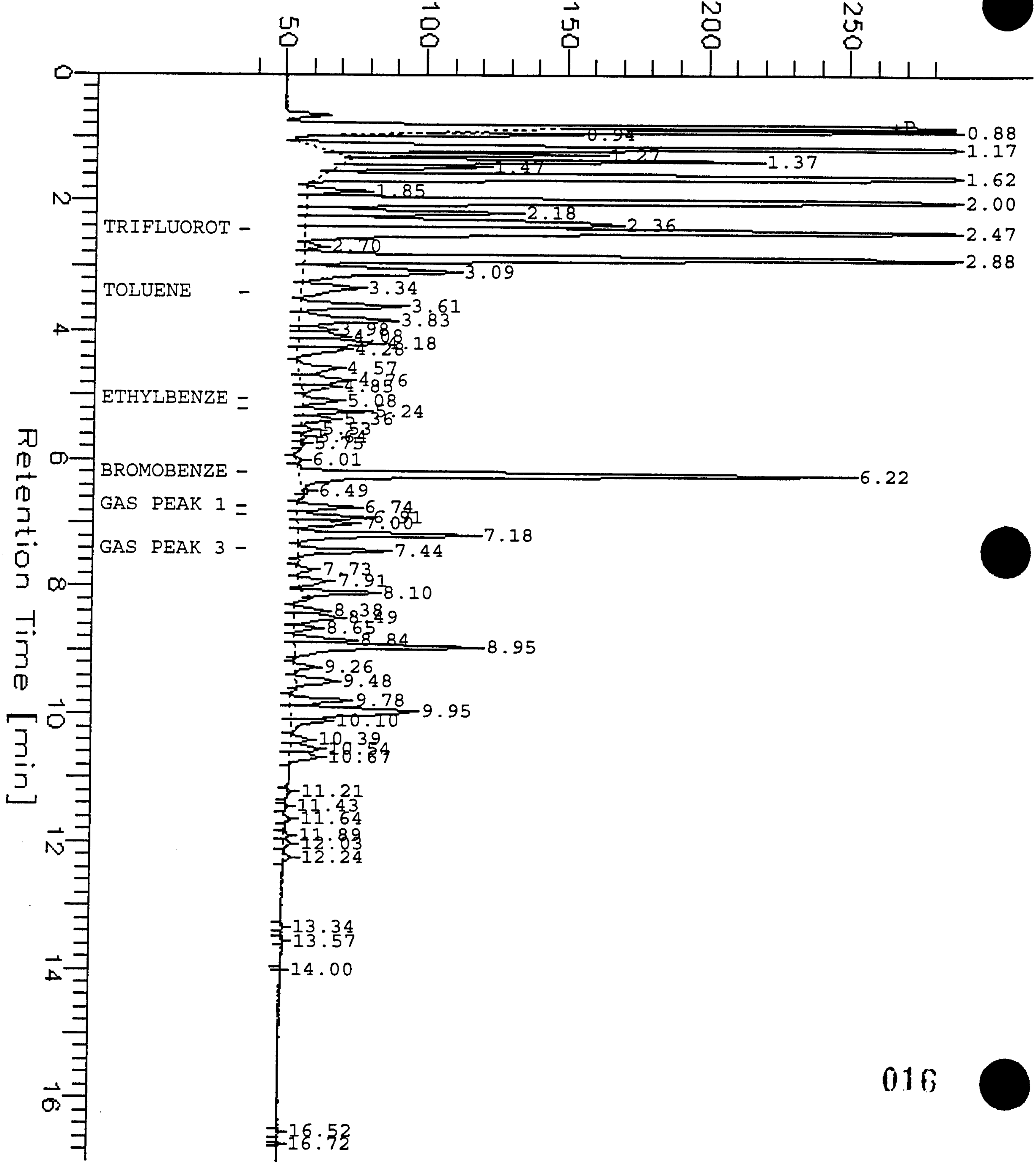
High Point : 287.62 mV

125615-001



FileName : G:\GC04\142J006.raw
Start Time : 0.00 min
Scale Factor: -1
End Time : 17.00 min
Plot Offset: 37 mV
Date : 5/21/96 2:06 PM
Low Point : 37.40 mV
Plot Scale: 250 mV
Page 1 of 1
High Point : 287.40 mV

125615- 003



Curtis & Tompkins, Ltd.

Lab #: 125615 BATCH QC REPORT 

## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

### MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: ZZZZZZ
Lab ID: 125496-009
Matrix: Water
Batch#: 27666
Units: ug/L
Diln Fac: 1

Sample Date: 05/08/96
Received Date: 05/08/96
Prep Date: 05/18/96
Analysis Date: 05/18/96

MS Lab ID: QC22014

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 2000 | <50.00 | 2075 | 104 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 104 | 69-120 |
| Bromobenzene | 103 | 70-122 |

MSD Lab ID: QC22015

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 2000 | 2069 | 104 | 75-125 | 0 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 105 | 69-120 |
| Bromobenzene | 105 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

Curtis & Tompkins, Ltd.

Lab #: 125615

BATCH QC REPORT



| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| MATRIX SPIKE/MATRIX SPIKE DUPLICATE | |
|---|---|
| Field ID: ZZZZZZ | Sample Date: 05/16/96 |
| Lab ID: 125616-004 | Received Date: 05/17/96 |
| Matrix: Water | Prep Date: 05/21/96 |
| Batch#: 27719 | Analysis Date: 05/21/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MS Lab ID: QC22224

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 2000 | <50.00 | 1796 | 90 | 75-125 |
| Surrogate | %Rec | Limits | | | |
| Trifluorotoluene | 91 | 69-120 | | | |
| Bromobenzene | 96 | 70-122 | | | |

MSD Lab ID: QC22225

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 2000 | 1667 | 83 | 75-125 | 8 | <20 |
| Surrogate | %Rec | Limits | | | | |
| Trifluorotoluene | 77 | 69-120 | | | | |
| Bromobenzene | 82 | 70-122 | | | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

Curtis & Tompkins, Ltd.

Lab #: 125615 BATCH QC REPORT 

## TVH-Total Volatile Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

## LABORATORY CONTROL SAMPLE

| | | | |
|---|---|---|---|
| Matrix: | Water | Prep Date: | 05/18/96 |
| Batch#: | 27666 | Analysis Date: | 05/18/96 |
| Units: | ug/L | | |
| Diln Fac: | 1 | | |

LCS Lab ID: QC22012

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 2005 | 2000 | 100 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 100 | 69-120 |
| Bromobenzene | 100 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
'pike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd.



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

## LABORATORY CONTROL SAMPLE

| | |
|---|---|
| Matrix: Water | Prep Date: 05/21/96 |
| Batch#: 27719 | Analysis Date: 05/21/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

LCS Lab ID: QC22221

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 1802 | 2006 | 90 | 80-120 |
| Surrogate | %Rec | Limits | | |
| Trifluorotoluene | 92 | 69-120 | | |
| Bromobenzene | 94 | 70-122 | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd

Lab #: 125615 BATCH QC REPORT 

| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: CA LUFT (EPA 8015M)<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Water<br>Batch#: 27666<br>Units: ug/L<br>Diln Fac: 1 | Prep Date: 05/18/96<br>Analysis Date: 05/18/96 |

MB Lab ID: QC22011

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| Surrogate | %Rec | Recovery Limits |
| Trifluorotoluene | 99 | 69-120 |
| Bromobenzene | 104 | 70-122 |

| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| METHOD BLANK | |
|---|---|
| Matrix: Water | Prep Date: 05/21/96 |
| Batch#: 27719 | Analysis Date: 05/21/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MB Lab ID: QC22223

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 84 | 69-120 |
| Bromobenzene | 82 | 70-122 |

Curtis & Tompkins, Ltd


## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 125615-001 | BE-MP10-01 | 27666 | 05/14/96 | 05/19/96 | 05/19/96 | |
| 125615-002 | BE-MP12-01 | 27666 | 05/15/96 | 05/19/96 | 05/19/96 | |
| 125615-003 | BE-MP13-01 | 27719 | 05/14/96 | 05/21/96 | 05/21/96 | |
| 125615-004 | BE-MP47-01 | 27666 | 05/14/96 | 05/19/96 | 05/19/96 | |

Matrix: Water

| Analyte<br>Diln Fac: | Units | 125615-001<br>1 | 125615-002<br>1 | 125615-003<br>5 | 125615-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | ug/L | 1400 | <50 | 5900 | <50 |
| Surrogate | | | | | |
| Trifluorotoluene | %REC | 96 | 89 | 90 | 92 |
| Bromobenzene | %REC | 117 | 89 | 98 | 93 |

## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 125615-005 | TRIP BLANK | 27666 | 05/15/96 | 05/19/96 | 05/19/96 | |

Matrix: Water

| Analyte<br>Diln Fac: | Units | 125615-005<br>1 |
|---|---|---|
| Gasoline | ug/L | <50 |
| Surrogate | | |
| Trifluorotoluene | %REC | 92 |
| Bromobenzene | %REC | 93 |

Beale 4-B

Curtis & Tompkins Ltd

# COOLER RECEIPT CHECKLIST

Login#: 125615 Date Received: 5/7 Number of Coolers: /
Client: PG&E-Swm Project: 722450.14020 Beale 4-B

A. Preliminary Examination Phase
Date Opened: 5/7 By (print): J.Williams (sign) J.Williams

1. Did cooler come with a shipping slip (airbill, etc.)?................................... YES NO
If YES, enter carrier name and airbill number: Fed Ex 1154092505
2. Were custody seals on outside of cooler?................................... YES NO
How many and where?______ Seal date:______ Seal name: N/A
3. Were custody seals unbroken and intact at the date and time of arrival?........... YES NO N/A
4. Were custody papers dry and intact when received?................................... YES NO
5. Were custody papers filled out properly (ink, signed, etc.)?........................ YES NO
6. Did you sign the custody papers in the appropriate place?........................... YES NO
7. Was project identifiable from custody papers?................................... YES NO
If YES, enter project name at the top of this form.
8. If required, was sufficient ice used?................................... YES NO
Type of ice: Cube Temperature: 4.0°C

B. Login Phase
Date Logged In: 5/7 By (print): J.Williams (sign) J.Williams

1. Describe type of packing in cooler: bubble wrap
2. Did all bottles arrive unbroken?................................... YES NO
3. Were labels in good condition and complete (ID, date, time, signature, etc.)?... YES NO
4. Did bottle labels agree with custody papers?................................... YES NO
5. Were appropriate containers used for the tests indicated?........................... YES NO
6. Were correct preservatives added to samples?................................... YES NO
7. Was sufficient amount of sample sent for tests indicated?........................... YES NO
8. Were bubbles absent in VOA samples? If NO, list sample Ids below................. YES NO
9. Was the client contacted concerning this sample delivery?........................... YES NO
If YES, give details below.
Who was called?______ By whom?______ Date:______

Additional Comments:

Curtis & Tompkins, Ltd.

# TPH/Purgeable Data

Curtis & Tompkins, Ltd.

# Chain of Custody

PARSONS ENGINEERING SCIENCE, INC.
1301 Marina Village Pkwy, Suite 200
Alameda, California 94501
Phone: (510) 769-0100
FAX: (510) 769-9244

12561

# CHAIN OF CUSTODY RECORD



Project No.: 722450.14020
Project Name/Location: Beale AFB, UST Site
Project Manager: Todd Wiedemeier (Denver, CO)
Site Manager: Michael Phelps (Alameda, CA)
Sampler(s): (Initials and Signature(s))
Michael B. Phelps
[signature]

ANALYTES (METHOD): ORGANICS / INORGANICS / OTHER

Note: All analyses and holding times according to AFCEE handbook requirements.

| | Sample ID | Date | Time | Begin Depth | End Depth | Matrix | NO. OF CONTAINERS | TPH-gasoline (5030/8015m) see note 1 | Extractable TPH (3550/8015m) see note 1 | BTEX and TMBs (5030/8020) see notes 1, 2 | Halogenated VOCs (5030/8010) see notes 1,4 | SVOCs (3550/8270) see note 1 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BE-MP10-01 | 5/14/96 | 1055 | — | — | water | 2 | X | | X | | | |
| 2 | BE-MP12-01 | 5/15/96 | 1056 | — | — | water | 2 | X | | X | | | |
| 3 | BE-MP13-01 | 5/14/96 | 1245 | — | — | water | 2 | X | | X | | | |
| 4 | BE-MP47-01 | 5/14/96 | 1305 | — | — | water | 2 | X | | X | | | |
| 5 | Trip Blank | ~~5/16/96~~ [illegible] 5/15/96 | 1100 | — | — | water | 2 | X | | X | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |
| | | | | | | water | | | | | | | |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| [signature] | 5/16/96 | 1630 | |

NOTES:
1. Secondary column confirmation required.
2. Quantify all carbon ranges: diesel, jet fuel, oil/grease.
3. Deionized water extraction
4. TMBs: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LAB BY: (SIGNATURE) | DATE | TIME | REMARKS/COMMENTS: |
|---|---|---|---|---|---|---|
| [illegible] | | | [signature] | [illegible] | | Resampled due to laboratory-missed holding time. Expedite turn[illegible]! |

Distribution: Original accompanies shipment; photocopy kept by samplers; copy FAXed to Parsons ES Site Manager by laboratory upon receipt of samples

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

**COVER PAGE**

Laboratory Number 125615

Parsons Engineering Science, Inc.
1301 Marina Village Parkway
Suite 200
Alameda, CA 94501

Project#: 722450.14020
Location: Beale AFB

| Sample ID | Lab ID |
|---|---|
| BE-MP10-01 | 125615-001 |
| BE-MP12-01 | 125615-002 |
| BE-MP13-01 | 125615-003 |
| BE-MP47-01 | 125615-004 |
| TRIP BLANK | 125615-005 |

NOTE -
THESE ARE

I certify that this data package has been reviewed for technical correctness and completeness. Please see attached narrative for a discussion of any analytical problems related to this sample set. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signatures.

Signature: ______________________ Date: 5-23-96
Title: Operations Manager

Signature: Teresa K Morrison Date: 5/23/96
Title: Project Manager



Berkeley Irvine

Curtis & Tompkins, Ltd

**Laboratory Number: 125615**
**Client: Parsons Engineering Science**
**Project#: 722450.14020**
**Location: Beale AFB**

**Sample Date: 05/14,15/96**
**Receipt Date:05/17/96**

## CASE NARRATIVE

This hardcopy data package contains sample results and batch QC for four water samples and one trip blank received from the above referenced project on May 17, 1996. All samples were received cold and intact.

**TPH/Purgeable:** No analytical problems were encountered.

**BTXE (EPA 8020):** Because TPH/gasoline and BTXE are analyzed simultaneously, only one type of matrix spikes are performed. The matrix spikes associated with these samples were gasoline. Both laboratory control samples passed acceptance criteria and no analytical problems were encountered.

Beale

# COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login#: 124818 Date Received: 3/15 Number of Coolers: 1

Client: CS Project: Beale

A. Preliminary Examination Phase

Date Opened: 3/15 By (print): J. Willi (sign) [illegible]

1. Did cooler come with a shipping slip (airbill, etc.)?........by hand.............. YES NO

   If YES, enter carrier name and airbill number:

2. Were custody seals on outside of cooler?.............................................. YES NO

   How many and where? Seal date: Seal name: NA

3. Were custody seals unbroken and intact at the date and time of arrival?........... YES NO NA

4. Were custody papers dry and intact when received?.................................. YES NO

5. Were custody papers filled out properly (ink, signed, etc.)?............................ YES NO

6. Did you sign the custody papers in the appropriate place?............................. YES NO

7. Was project identifiable from custody papers?........................................ YES NO

   If YES, enter project name at the top of this form.

8. If required, was sufficient ice used?...................................................... YES NO

   Type of ice: wet Temperature: 4.25°C

B. Login Phase

Date Logged In: 3/16 By (print): J. Willi (sign) [illegible]

1. Describe type of packing in cooler: —

2. Did all bottles arrive unbroken?........................................................ YES NO

3. Were labels in good condition and complete (ID, date, time, signature, etc.)?... YES NO

4. Did bottle labels agree with custody papers?........................................ YES NO

5. Were appropriate containers used for the tests indicated?........................... YES NO

6. Were correct preservatives added to samples?........................................ YES NO

7. Was sufficient amount of sample sent for tests indicated?............................ YES NO

8. Were bubbles absent in VOA samples? If NO, list sample Ids below................. YES NO

9. Was the client contacted concerning this sample delivery?.............................. YES NO

   If YES, give details below.

   Who was called? By whom? Date:

Additional Comments:

Filename: F:\qc\forms\cooler.wpd Rev. 1 4/95

Curtis & Tompkins, Ltd



## BTXE

lient: Parsons Engineering Science, Inc.
roject#: 722450.14020
Location: Beale AFB

Analysis Method: EPA 8020
Prep Method: EPA 5030

## LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 26707
Units: ug/L
Diln Fac: 1

Prep Date: 03/29/96
Analysis Date: 03/29/96

LCS Lab ID: QC18179

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Benzene | 20.8 | 20 | 104 | 80-120 |
| Toluene | 21.3 | 20 | 107 | 80-120 |
| Ethylbenzene | 19.9 | 20 | 100 | 80-120 |
| m,p-Xylenes | 42.9 | 40 | 107 | 80-120 |
| o-Xylene | 20.9 | 20 | 105 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 97 | 58-130 |
| Bromobenzene | 86 | 62-131 |

# Column to be used to flag recovery and RPD values with an asterisk
lues outside of QC limits
e Recovery: 0 out of 5 outside limits

Engineering-Science, Inc.
1301 Marina Village Parkway, Suite 200
Alameda, California 94501
Phone: (510) 769-0100 Fax: (510) 769-9244

124849

# CHAIN OF CUSTODY RECORD

PAGE ____ OF ____

LABORATORY: C&T

PROJECT MANAGER: M. Phelps

PROJ. #: 722450.14020

PROJECT NAME/LOCATION: Beale AFB UST Site

SAMPLER(S): (SIGNATURE) Marcus Pierce Marcus Pierce

| | SAMPLE ID | DATE | TIME | MATRIX | SAMPLE LOCATION | NO. OF CONTAINERS | TPH-g BTEX TMBs | TPH-D | | | | | | TO BE COMPOSITED BY LAB | TURN AROUND TIME | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BE-SW01-01 | 3/15/96 | 1120 | H2O | Drainage Ditch | 4 | X | X | | | | | | | | |
| 2 | BE-SW02-01 | | 1220 | | " " | 4 | X | X | | | | | | | | |
| 3 | BE-SW12-01 | | 1230 | | " " | 4 | X | X | | | | | | | | |
| 4 | BE-SW03-01 | | 1415 | | " " | 4 | X | X | | | | | | | | |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) | RELINQUISHED BY(SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|---|---|---|---|
| Marcus J. Pierce | 3/15/96 | 1830 | | | | | |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LABORATORY BY: (SIGNATURE) | DATE | TIME | REMARKS: |
|---|---|---|---|---|---|---|
| | | | Tuesa Morr | 3/15/96 | 1830 | |

DISTRIBUTION: WHITE: ACCOMPANIES SHIPMENT & RET'N WITH LAB REPORT, CANARY: LAB COPY, PINK: FIELD COPY

c:\user\cdr\coceg.cdr

Curtis & Tompkins, Ltd.



## BTXE

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | EPA 8020 |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124848-001 | BE-SW01-01 | 26707 | 03/15/96 | 03/29/96 | 03/29/96 | |
| 124848-002 | BE-SW02-01 | 26707 | 03/15/96 | 03/29/96 | 03/29/96 | |
| 124848-003 | BE-SW12-01 | 26707 | 03/15/96 | 03/29/96 | 03/29/96 | |
| 124848-004 | BE-SW03-01 | 26707 | 03/15/96 | 03/29/96 | 03/29/96 | |

| Analyte | Units | 124848-001 | 124848-002 | 124848-003 | 124848-004 |
|---|---|---|---|---|---|
| Diln Fac: | | 1 | 1 | 1 | 1 |
| Benzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| Toluene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| Ethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| m,p-Xylenes | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| o-Xylene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,2,3-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,2,4-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,3,5-Trimethylbenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 |
| **Surrogate** | | | | | |
| Trifluorotoluene | %REC | 94 | 95 | 94 | 95 |
| Bromobenzene | %REC | 82 | 82 | 80 | 82 |

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| BTXE | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: EPA 8020<br>Prep Method: EPA 5030 |

| METHOD BLANK | |
|---|---|
| Matrix: Water<br>Batch#: 26707<br>Units: ug/L<br>Diln Fac: 1 | Prep Date: 03/29/96<br>Analysis Date: 03/29/96 |

MB Lab ID: QC18177

| Analyte | Result | |
|---|---|---|
| Benzene | <0.5 | |
| Toluene | <0.5 | |
| Ethylbenzene | <0.5 | |
| m,p-Xylenes | <0.5 | |
| o-Xylene | <0.5 | |
| 1,2,3-Trimethylbenzene | <0.5 | |
| 1,2,4-Trimethylbenzene | <0.5 | |
| 1,3,5-Trimethylbenzene | <0.5 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 95 | 58-130 |
| Bromobenzene | 83 | 62-131 |

Curtis & Tompkins, Ltd

Lab #: 124848

BATCH QC REPORT



TVH-Total Volatile Hydrocarbons

| | | | |
|---|---|---|---|
| Client: | Parsons Engineering Science, Inc. | Analysis Method: | CA LUFT (EPA 8015M) |
| Project#: | 722450.14020 | Prep Method: | EPA 5030 |
| Location: | Beale AFB | | |

LABORATORY CONTROL SAMPLE

| | | | |
|---|---|---|---|
| Matrix: | Water | Prep Date: | 03/28/96 |
| Batch#: | 26707 | Analysis Date: | 03/28/96 |
| Units: | ug/L | | |
| Diln Fac: | 1 | | |

LCS Lab ID: QC18178

| Analyte | Result | Spike Added | %Rec # | Limits |
|---|---|---|---|---|
| Gasoline | 1938 | 2000 | 97 | 80-120 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 102 | 69-120 |
| Bromobenzene | 106 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd.



| TVH-Total Volatile Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| MATRIX SPIKE/MATRIX SPIKE DUPLICATE | |
|---|---|
| Field ID: ZZZZZZ | Sample Date: 03/15/96 |
| Lab ID: 124892-016 | Received Date: 03/19/96 |
| Matrix: Water | Prep Date: 03/28/96 |
| Batch#: 26707 | Analysis Date: 03/28/96 |
| Units: ug/L | |
| Diln Fac: 1 | |

MS Lab ID: QC18304

| Analyte | Spike Added | Sample | MS | %Rec # | Limits |
|---|---|---|---|---|---|
| Gasoline | 2000 | <50.00 | 1885 | 94 | 75-125 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 102 | 69-120 |
| Bromobenzene | 105 | 70-122 |

MSD Lab ID: QC18305

| Analyte | Spike Added | MSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Gasoline | 2000 | 1841 | 92 | 75-125 | 2 | <20 |

| Surrogate | %Rec | Limits |
|---|---|---|
| Trifluorotoluene | 102 | 69-120 |
| Bromobenzene | 105 | 70-122 |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

Curtis & Tompkins, Ltd



## TVH-Total Volatile Hydrocarbons

| | |
|---|---|
| lient: Parsons Engineering Science, Inc. | Analysis Method: CA LUFT (EPA 8015M) |
| Project#: 722450.14020 | Prep Method: EPA 5030 |
| Location: Beale AFB | |

| Sample # | Client ID | Batch # | Sampled | Extracted | Analyzed | Moisture |
|---|---|---|---|---|---|---|
| 124848-001 | BE-SW01-01 | 26707 | 03/15/96 | 03/29/96 | 03/29/96 | |
| 124848-002 | BE-SW02-01 | 26707 | 03/15/96 | 03/29/96 | 03/29/96 | |
| 124848-003 | BE-SW12-01 | 26707 | 03/15/96 | 03/29/96 | 03/29/96 | |
| 124848-004 | BE-SW03-01 | 26707 | 03/15/96 | 03/29/96 | 03/29/96 | |

| Analyte<br>Diln Fac: | Units | 124848-001<br>1 | 124848-002<br>1 | 124848-003<br>1 | 124848-004<br>1 |
|---|---|---|---|---|---|
| Gasoline | ug/L | <50 | <50 | <50 | <50 |
| Surrogate | | | | | |
| Trifluorotoluene | %REC | 97 | 97 | 96 | 98 |
| romobenzene | %REC | 89 | 89 | 87 | 89 |

Curtis & Tompkins, Ltd



## TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 722450.14020
Location: Beale AFB

Analysis Method: CA LUFT (EPA 8015M
Prep Method: EPA 5030

## METHOD BLANK

Matrix: Water
Batch#: 26707
Units: ug/L
Diln Fac: 1

Prep Date: 03/29/96
Analysis Date: 03/29/96

MB Lab ID: QC18177

| Analyte | Result | |
|---|---|---|
| Gasoline | <50 | |
| **Surrogate** | **%Rec** | **Recovery Limits** |
| Trifluorotoluene | 96 | 69-120 |
| Bromobenzene | 89 | 70-122 |

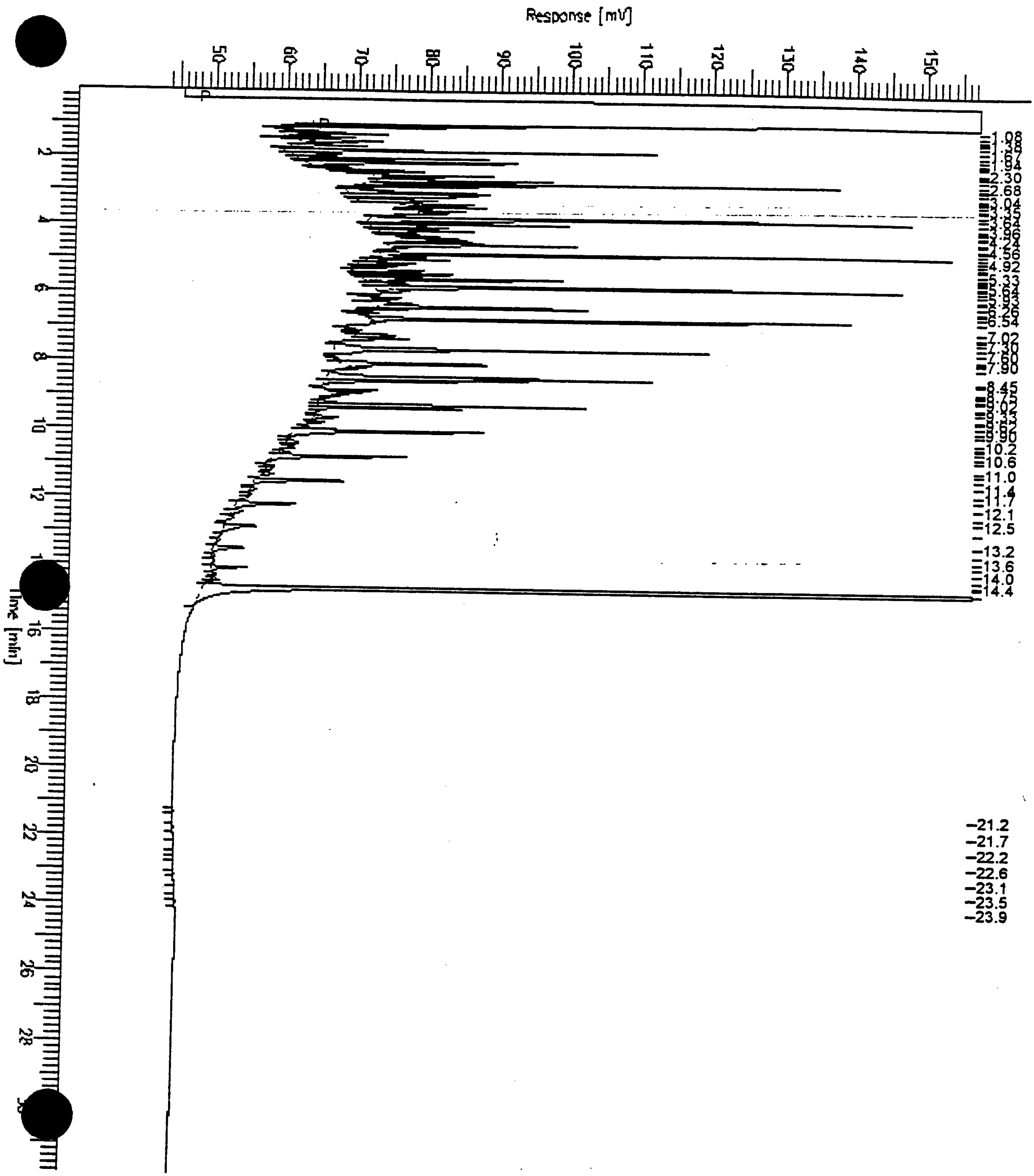
Diesel

# GC15 Channel A TEH

Sample Name : CCV,96WS1948,DSL
FileName : C:\GC15\CHB\080B047.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0
End Time : 31.91 min
Plot Offset: 44 mV

Sample #: 500MG/L
Date : 3/25/96 05:16 PM
Time of Injection: 3/22/96 01:48 AM
Low Point : 43.61 mV
Plot Scale: 113.8 mV
High Point : 157.43 mV



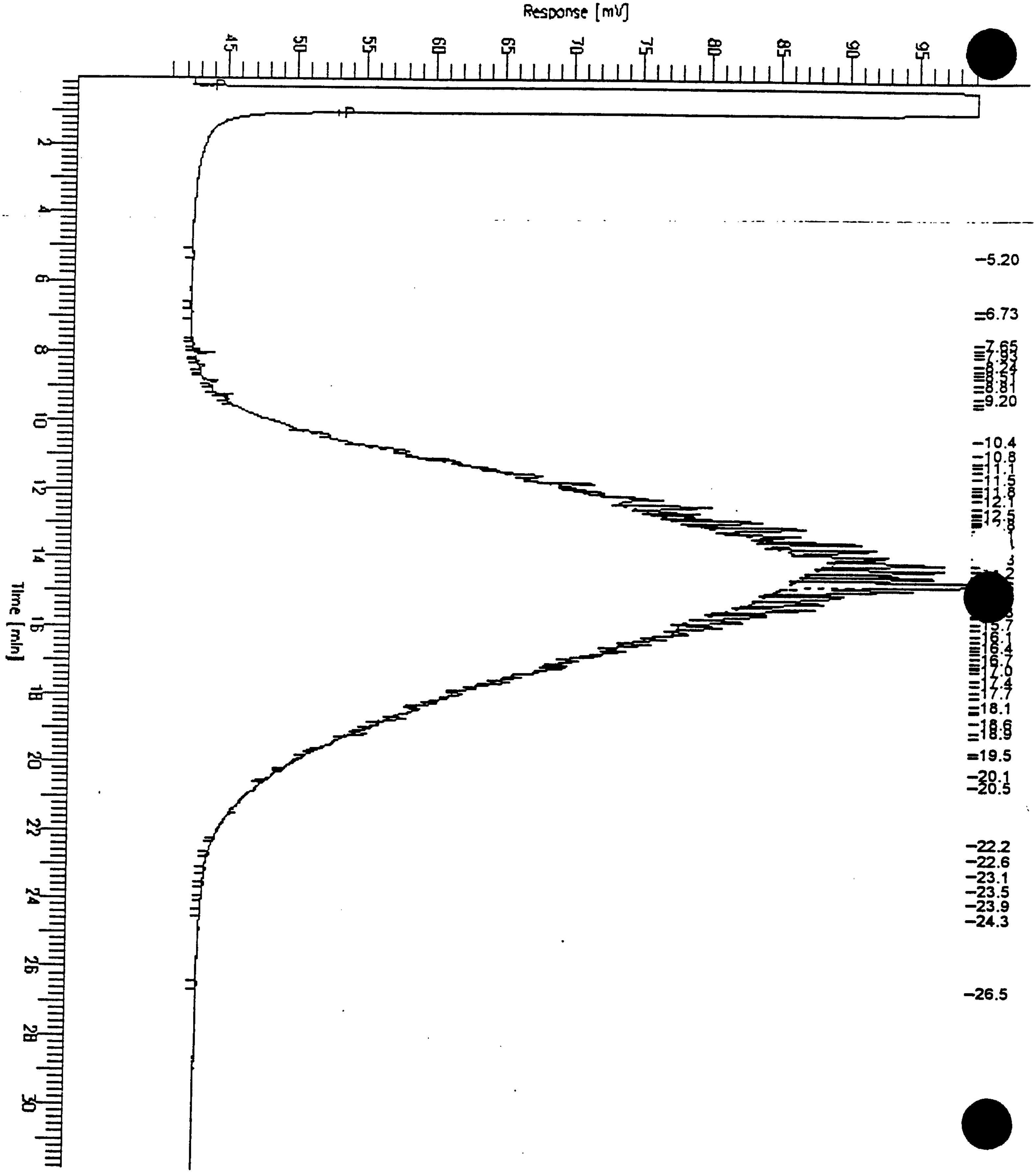


Motor Oil

Sample Name : CCV,95WS1596,MO
FileName : C:\GC15\CHB\080B051.RAW
Methoo : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0
End Time : 31.91 min
Plot Offset: 41 mV

Sample #: 500MG/L
Date : 3/25/96 05:14 PM
Time of Injection: 3/22/96 04:44 AM
Low Point : 40.69 mV
Plot Scale: 58.5 mV
High Point : 99.19 mV



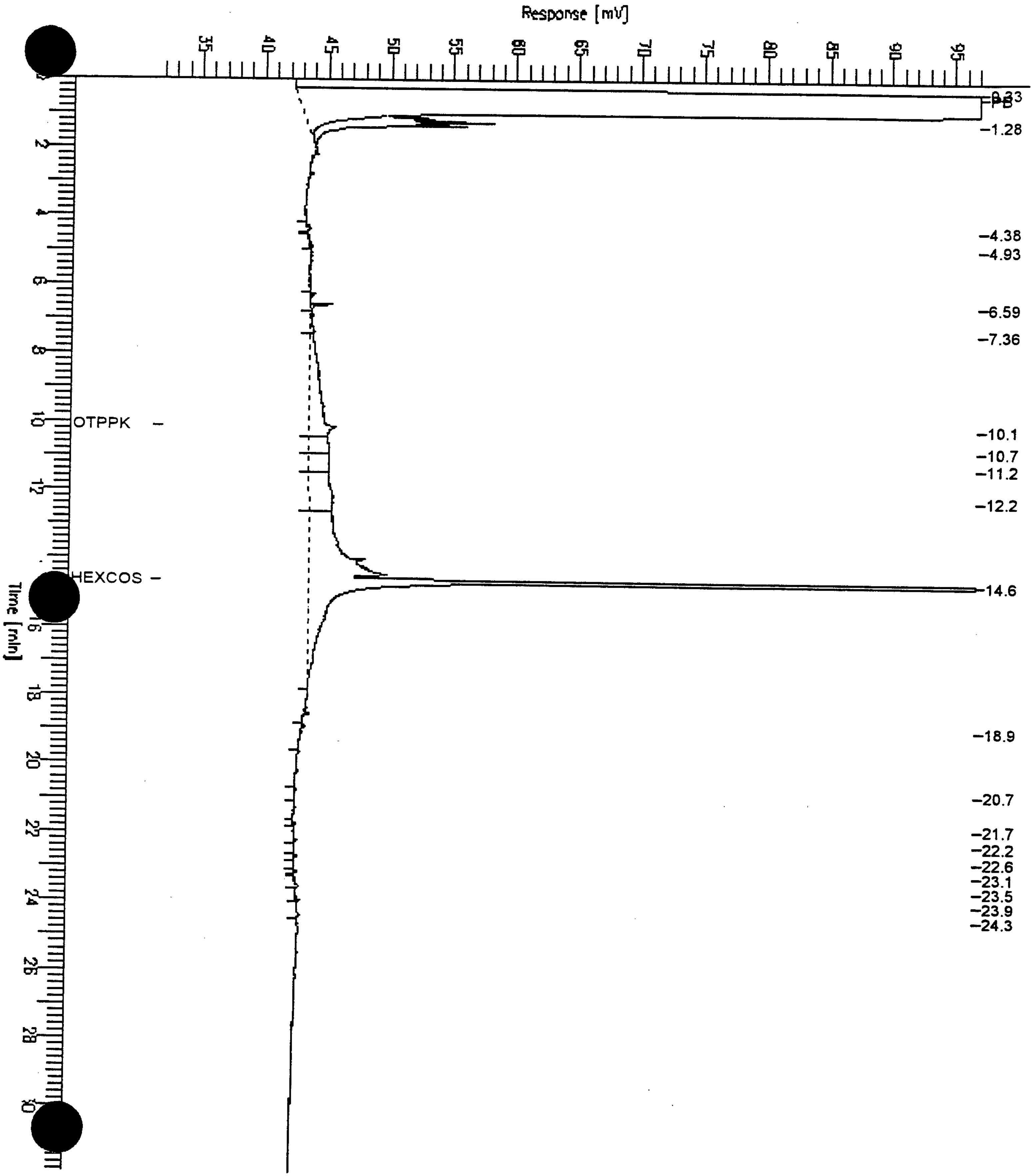


GC15 Channel A Surrogate

Sample Name : S,124848-003,26513
FileName : C:\GC15\CHB\080B055.raw
Method : DUAL
Start Time : 0.00 min
Scale Factor: 0.0
End Time : 31.90 min
Plot Offset: 32 mV

Sample #: 500:2.5
Date : 3/22/96 08:13 AM
Time of Injection: 3/22/96 07:39 AM
Low Point : 32.00 mV
Plot Scale: 65.0 mV
High Point : 97.00 mV

Page 1 of 1



JP-5

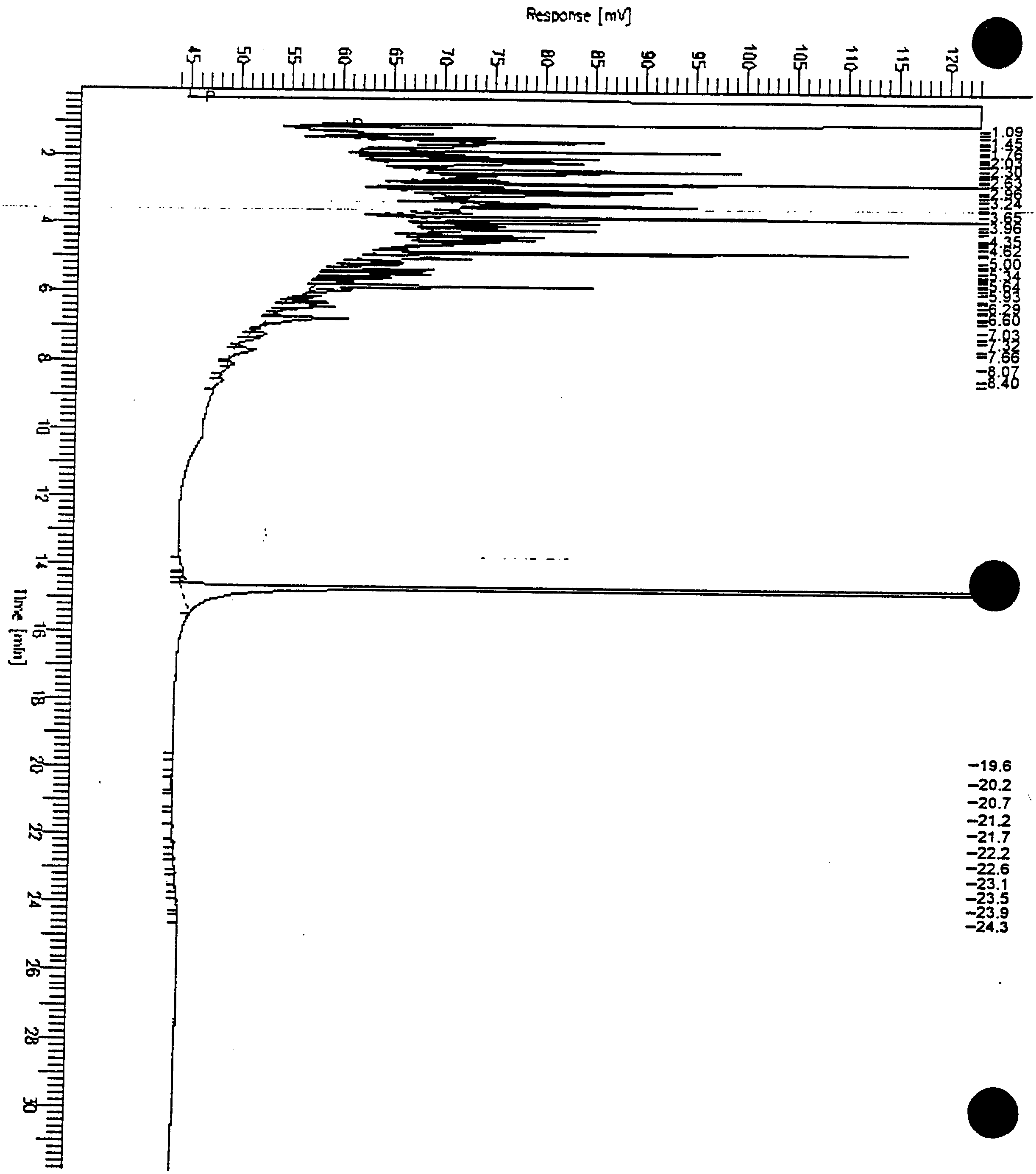


Sample Name : CCV,96WS2068,JP5
FileName : C:\GC15\CHB\080B050.RAW
Method : BTEH.MTH
Start Time : 0.01 min
Scale Factor: 0.0
End Time : 31.91 min
Plot Offset: 43 mV

Sample #: 250MG/L
Date : 3/25/96 05:13 PM
Time of Injection: 3/22/96 04:00 AM
Low Point : 43.16 mV
Plot Scale: 79.9 mV



High Point : 123.07 mV



Curtis & Tompkins, Ltd.

Lab #: 124848

BATCH QC REPORT



| TEH-Tot Ext Hydrocarbons | |
|---|---|
| Client: Parsons Engineering Science, Inc.<br>Project#: 722450.14020<br>Location: Beale AFB | Analysis Method: CA LUFT (EPA 8015M)<br>Prep Method: EPA 3520 |

| BLANK SPIKE/BLANK SPIKE DUPLICATE | |
|---|---|
| Matrix: Water<br>Batch#: 26513<br>Units: ug/L<br>Diln Fac: 1 | Prep Date: 03/19/96<br>Analysis Date: 03/21/96 |

BS Lab ID: QC17467

| Analyte | Spike Added | BS | %Rec # | Limits |
|---|---|---|---|---|
| Diesel Range | 2475 | 2218 | 90 | 60-140 |
| Surrogate | %Rec | Limits | | |
| Hexacosane | 96 | 60-140 | | |

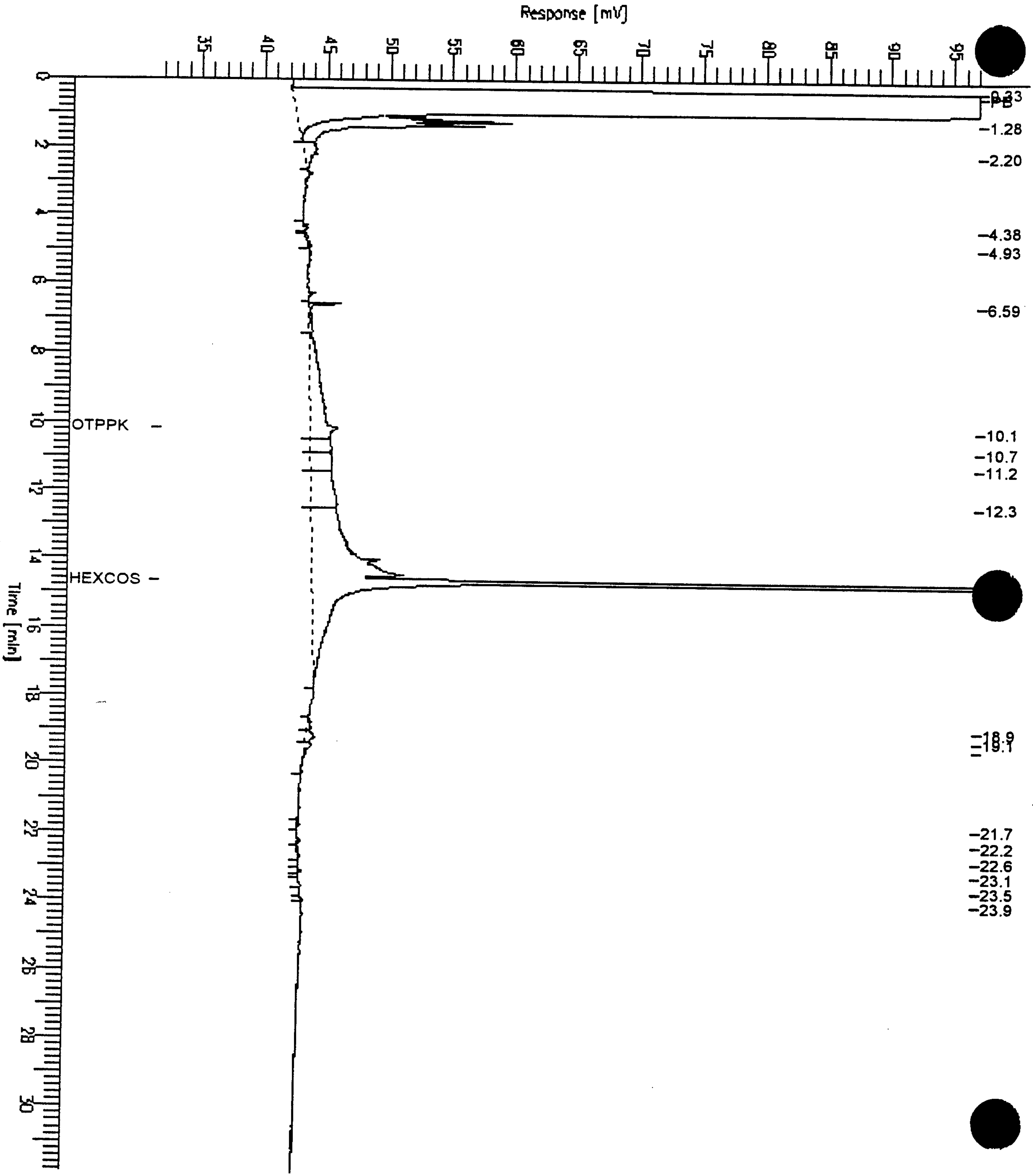
BSD Lab ID: QC17468

| Analyte | Spike Added | BSD | %Rec # | Limits | RPD # | Limit |
|---|---|---|---|---|---|---|
| Diesel Range | 2475 | 2330 | 94 | 60-140 | 5 | <35 |
| Surrogate | %Rec | Limits | | | | |
| Hexacosane | 95 | 60-140 | | | | |

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 1 outside limits
Spike Recovery: 0 out of 2 outside limits

Sample Name : S,124848-002,26513
FileName : C:\GC15\CHB\080B054.raw
Method : DUAL
Start Time : 0.00 min
Scale Factor: 0.0
End Time : 31.90 min
Plot Offset: 32 mV
Sample #: 500:2.5
Date : 3/22/96 07:29 AM
Time of Injection: 3/22/96 06:55 AM
Low Point : 32.00 mV
High Point : 97.00 mV
Plot Scale: 65.0 mV





# APPENDIX D

# MODEL INPUT PARAMETERS AND HYDRAULIC TESTING RESULTS

# CALIBRATED MODEL BOUNDARY CONDITIONS AND TRANSMISSIVITIES

## UST Sites 10-494, 10-495, and 10-496
## Intrinsic Remediation TS
## Beale AFB, California

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | | | | |
| 2 | | 129.75 | 129.67 | 129.58 | 129.50 | A | A | A | A | A | A | A | A | B | B | C | C | C | 126.09 | |
| 3 | | 129.71 | A | A | A | A | A | A | A | A | A | A | A | B | B | C | C | C | 125.98 | |
| 4 | | 129.68 | A | A | A | A | A | A | A | A | A | A | B | B | B | B | B | C | 125.86 | |
| 5 | | 129.64 | A | A | A | A | A | A | A | A | A | A | B | B | B | B | B | C | 125.75 | |
| 6 | | 129.61 | A | A | A | A | A | A | A | A | A | B | B | B | B | B | B | C | 125.64 | |
| 7 | | 129.57 | A | A | A | A | A | A | A | A | B | B | B | B | B | C | C | C | 125.59 | |
| 8 | | 129.54 | A | A | A | A | A | A | A | A | B | B | B | B | C | C | C | C | 125.54 | |
| 9 | | 129.50 | A | A | A | A | A | A | A | B | B | B | B | B | C | C | C | C | 125.48 | |
| 10 | | A | A | A | A | A | A | A | B | B | B | B | B | B | C | C | C | C | 125.43 | |
| 11 | | A | A | A | A | A | A | B | B | B | B | B | B | B | C | C | C | C | 125.38 | |
| 12 | | A | A | A | A | A | B | B | B | B | B | B | B | B | C | C | C | C | 125.32 | |
| 13 | | A | A | A | A | B | B | B | B | B | B | B | B | B | B | B | B | C | 125.27 | |
| 14 | | A | A | A | B | B | B | B | B | B | B | B | B | B | B | B | B | C | 125.21 | |
| 15 | | A | A | B | B | B | B | B | B | B | B | B | B | B | B | B | B | C | 125.16 | |
| 16 | | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | C | 125.11 | |
| 17 | | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | C | 125.05 | |
| 18 | | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | C | 125.00 | |
| 19 | | C | C | C | C | B | B | B | B | B | B | B | B | B | B | B | B | C | 124.95 | |
| 20 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.90 | |
| 21 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.85 | |
| 22 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.80 | |
| 23 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.75 | |
| 24 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.75 | |
| 25 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.70 | |
| 26 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.65 | |
| 27 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.60 | |
| 28 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.55 | |
| 29 | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | 124.50 | |
| 30 | | | | | | | | | | | | | | | | | | | | |

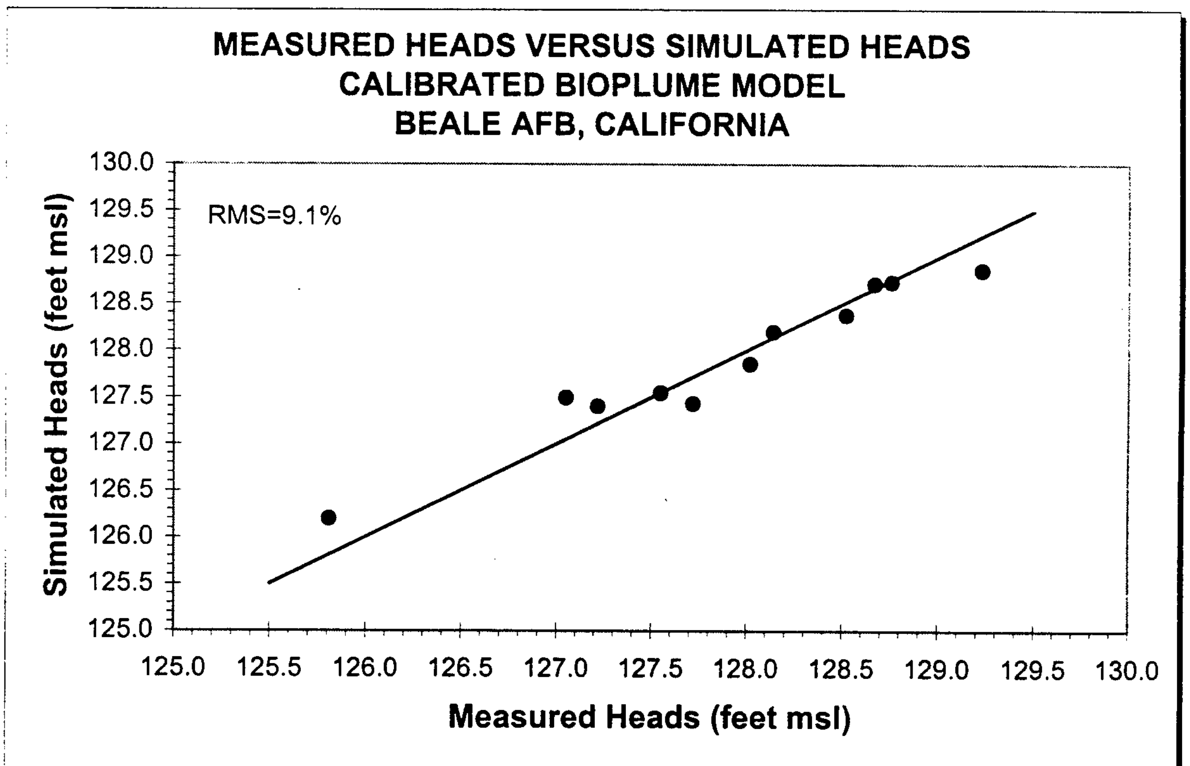
not to scale; grid dimensions are square (20 feet by 20 feet)

A: Transmissivity $=8.1 \times 10^{-4}$ ft/s
B: Transmissivity $= 3.96 \times 10^{-4}$ ft/s
C: Transmissivity $= 4.5 \times 10^{-5}$ ft/s

124.50 = Constant Head cell (feet)
= No flow cell

# ROOT-MEAN-SQUARE ERROR
# FOR THE CALIBRATED FLOW MODEL
## UST Sites 10-494, 10-495, and 10-496
## Intrinsic Remediation TS
## Beale AFB, California

| Location | x-grid | y-grid | $h_m$, Measured Head (feet msl) | $h_s$, Simulated Head (ft msl) | $(h_m - h_s)^2$ ($ft^2$) |
|---|---|---|---|---|---|
| MW-1 | 7 | 12 | 129.23 | 128.86 | 0.137 |
| MP-9 | 9 | 11 | 128.67 | 128.71 | 0.002 |
| MP-10 | 12 | 13 | 128.14 | 128.20 | 0.003 |
| MP-11 | 17 | 5 | 128.02 | 127.86 | 0.027 |
| MP-12 | 16 | 10 | 127.05 | 127.49 | 0.197 |
| MP-13 | 16 | 14 | 127.22 | 127.40 | 0.034 |
| MP-14 | 14 | 18 | 127.55 | 127.55 | 0.000 |
| MP-15 | 11 | 22 | 127.72 | 127.43 | 0.082 |
| MP-17 | 15 | 24 | 125.81 | 126.20 | 0.149 |
| MP-21 | 3 | 17 | 128.76 | 128.73 | 0.001 |
| MP-22 | 8 | 17 | 128.52 | 128.37 | 0.021 |
| | | | | RMS Error (ft) = | 0.243 |
| Difference between minimum and maximum simulated heads (ft) = | | | | | 2.66 |
| | | | | RMS Error (%)= | 9.1% |



# EXAMPLE SOURCE TERM CALCULATION FOR RESIDUAL LNAPL
## UST Sites 10-494, 10-495, and 10-496
## Intrinsic Remediation TS
## Beale AFB, California

**Current Conditions (MP-10)**

| Contaminant | $C_s$, Conc. Measured in Soil (mg/kg) | % Analyte in TPH (%) | % Analyte in Fresh Gasoline (%) | $C_f$, Conc. in Fresh Gasoline (mg/L) | $C_{fl}$, Leachable Conc. (mg/L) | $K_{fw}$, Fuel-Water Partition Coefficient | $C_w$, Concentration in Recharge (mg/L) | Leaching Rate To Groundwater (mg/day-ft$^2$) |
|---|---|---|---|---|---|---|---|---|
| Benzene | 0.0 | 0.0 | 1.8 | 15,928 | 0.0 | 291 | 0.0 | 0.0 |
| Toluene | 0.0 | 0.0 | 7.1 | 61,723 | 0.0 | 1,073 | 0.0 | 0.0 |
| Ethylbenzene | 0.0 | 0.0 | 1.8 | 15,648 | 0.0 | 3,956 | 0.0 | 0.0 |
| Xylenes | 2.2 | 0.282 | 9.0 | 77,858 | 2450 | 3,665 | 0.67 | 0.00479 |
| TOTAL | | | | | | | | 0.00479 |

Mass Loading: 1.92 mg/day-cell
BTEX Concentration: 0.16 mg/l-cell
BTEX Concentration: 157 ug/l-cell

**Calculated Initial Conditions (MP-10)**

| Contaminant | $C_s$, Conc. Measured in Soil (mg/kg) | % Analyte in TPH (%) | % Analyte in Fresh Gasoline (%) | $C_f$, Conc. in Fresh Gasoline (mg/L) | $C_{fl}$, Leachable Conc. (mg/L) | $K_{fw}$, Fuel-Water Partition Coefficient | $C_w$, Concentration in Recharge (mg/L) | Leaching Rate To Groundwater (mg/day-ft$^2$) |
|---|---|---|---|---|---|---|---|---|
| Benzene | 17.8 | 2.3 | 1.8 | 15,928 | 19,786 | 291 | 68.1 | 0.488 |
| Toluene | 69.0 | 8.8 | 7.1 | 61,723 | 76,673 | 1,073 | 71.5 | 0.513 |
| Ethylbenzene | 17.5 | 2.2 | 1.8 | 15,648 | 19,437 | 3,956 | 4.9 | 0.035 |
| Xylenes | 86.9 | 11.1 | 9.0 | 77,858 | 96,716 | 3,665 | 26.4 | 0.189 |
| TOTAL | | | | | | | | 1.23 |

Mass Loading: 490 mg/day-cell
BTEX Concentration: 40.1 mg/l-cell
BTEX Concentration: 40,102 ug/l-cell

**Calculated First-Order Decay Rate**

0.000447 per day
0.16 per year

# EXAMPLE SOURCE TERM CALCULATION FOR RESIDUAL LNAPL (continued)

## UST Sites 10-494, 10-495, and 10-496
## Intrinsic Remediation TS
## Beale AFB, California

**NOTES AND ASSUMPTIONS**

| **Properties of Gasoline** | | Source: Wiedemeier et al. (1995) | | | |
|---|---|---|---|---|---|
| | density ($g/m^3$) | $K_{fw}$ (-) | $F_f$ (-) | $C_f$ (mg/L) | $C_w$ (mg/L) |
| Gasoline | 720,000 | | | | |
| Benzene | 868,000 | 291 | 1.8 | 15,928 | 54.8 |
| Toluene | 866,900 | 1,073 | 7.1 | 61,723 | 57.6 |
| Ethylbenzene | 866,900 | 3,956 | 1.8 | 15,648 | 4.0 |
| Xylenes | 868,467 | 3,665 | 9.0 | 77,858 | 21.2 |
| TOTAL | | | 19.7 | | |

| | | | |
|---|---|---|---|
| current TPH in soil | 780 | mg/kg | [analytical result at MP-10] |
| Initial TPH in soil | 969 | mg/kg | =(780-2.2)/(1-0.197) |
| recharge rate | 1.11 | in/yr | [5% of annual rainfall] |
| recharge rate | 2.53E-04 | ft/day | |
| cell area | 400 | ft2/cell | |
| constant | 28.3 | L/ft3 | |
| injection rate | 5.00E-06 | ft^3/s | |

$K_{fw}$ = fuel-water partition coefficient
$F_m$ = mass fraction of compound in gasoline
$C_f$ ($g/m^3$) = Concentration in fuel
$C_{sat}$ ($g/m^3$) = Concentration in water

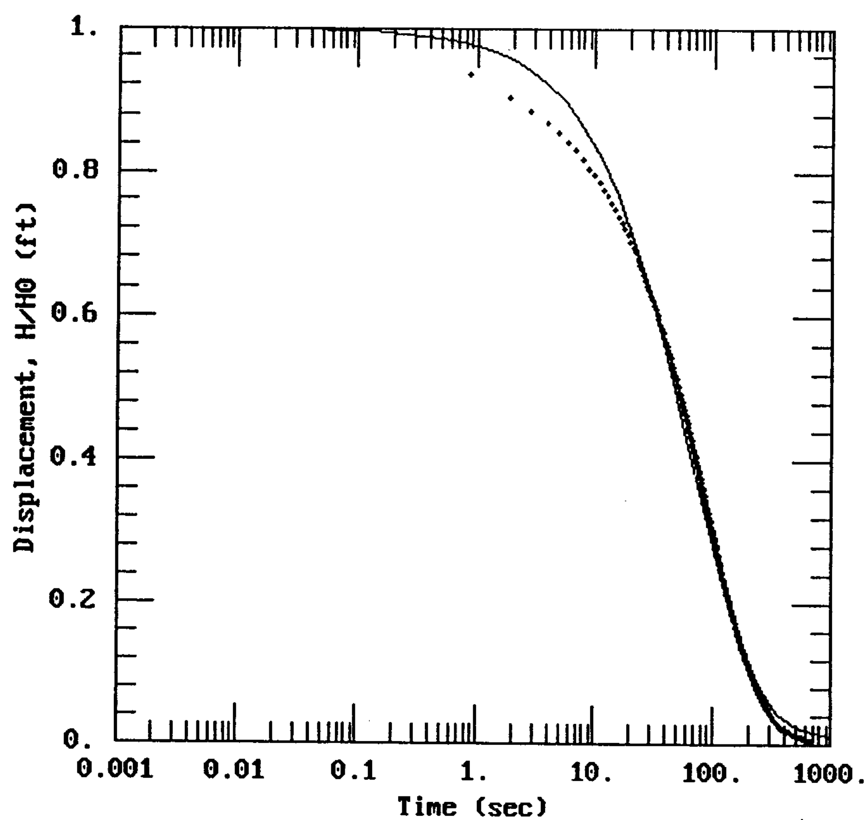
CLIENT: AFCEE

LOCATION: UST Site -- Beale AFB, CA

COMPANY: Parsons Engineering Science

PROJECT: 722450.14

# MW-1 (Rising Head Test #1)




DATA SET:
AM11R.DAT
10/31/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 2.114 ft
$r_c$= 0.083 ft
$r_w$= 0.344 ft

PARAMETER ESTIMATES:
T = 0.0002351 $ft^2$/sec
S = 1.E-05

AQTESOLV

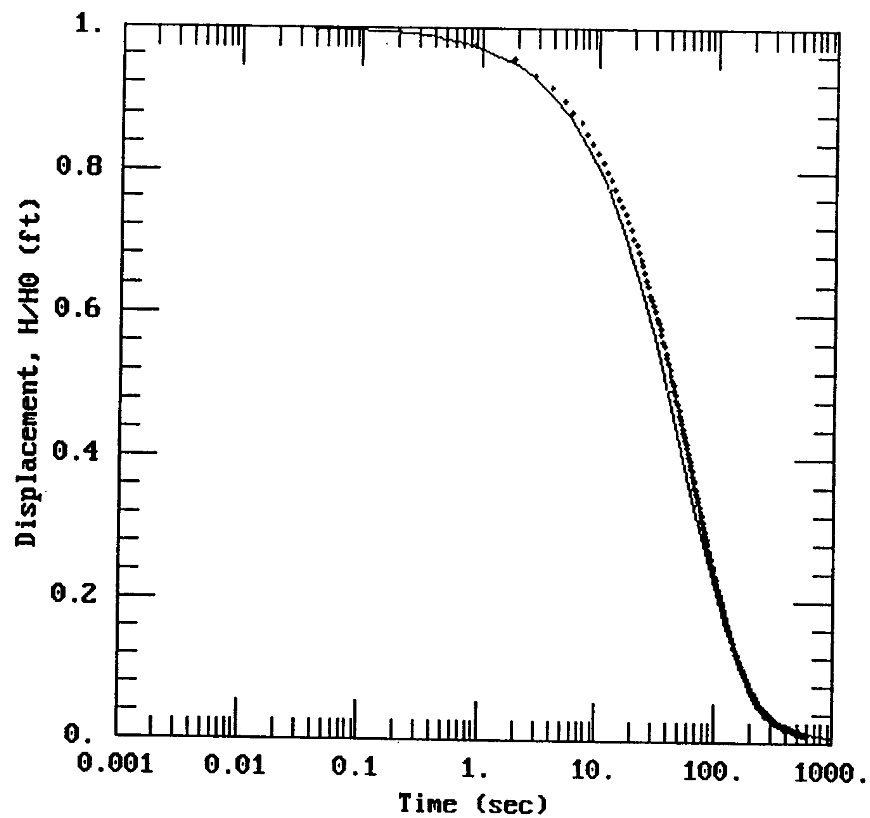
CLIENT: AFCEE

LOCATION: UST Site -- Beale AFB, CA

COMPANY: Parsons Engineering Science

PROJECT: 722450.14

# MW-1 (Rising Head Test #2)




DATA SET:
AM12R.DAT
10/31/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

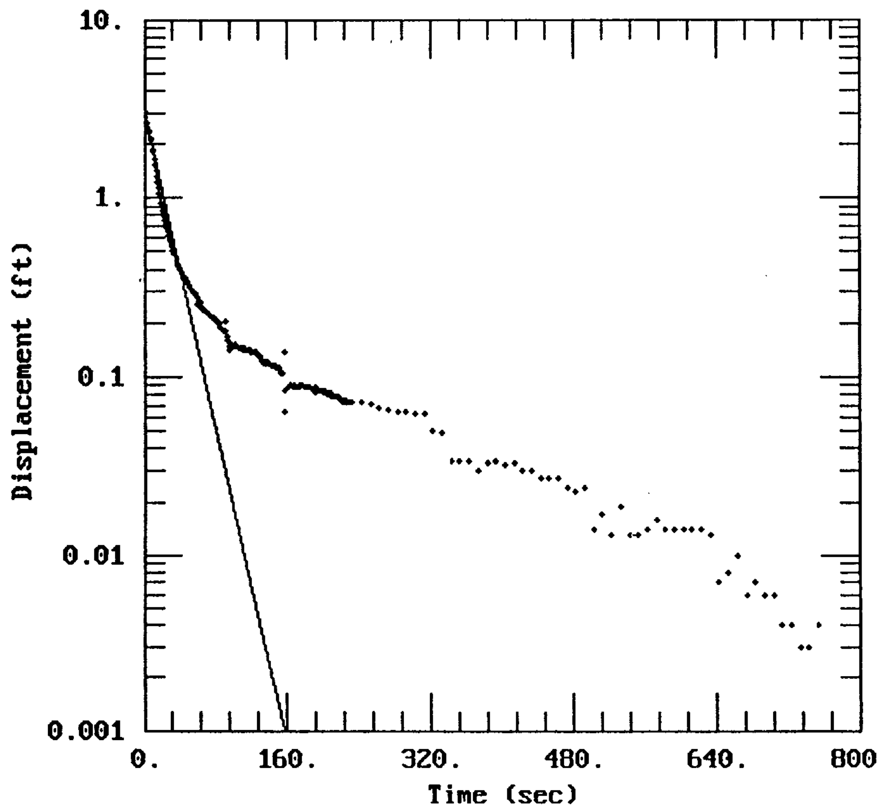
TEST DATA:
H0= 1.516 ft
$r_c$= 0.083 ft
$r_w$= 0.344 ft

PARAMETER ESTIMATES:
T = 0.0002924 $ft^2$/sec
S = 1.E-05

AQTESOLV

| | |
|---|---|
| CLIENT: AFCEE | COMPANY: Parsons Engineering Science |
| LOCATION: UST Site -- Beale AFB, CA | PROJECT: 722450.14 |

# MW-2 (Falling Head Test #1)




DATA SET:
AM21F.DAT
10/31/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3.039 ft
$r_c$= 0.083 ft
$r_w$= 0.344 ft
L = 3. ft
b = 3. ft
H = 3. ft

PARAMETER ESTIMATES:
K = 9.087E-05 ft/sec
y0 = 2.925 ft

AQTESOLV

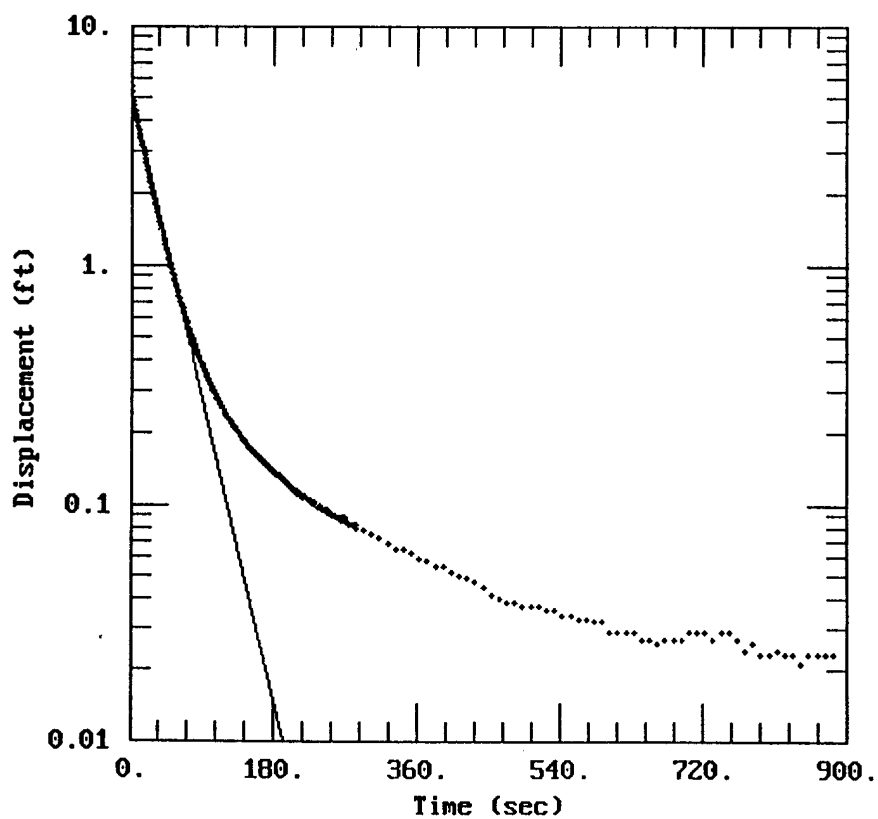
CLIENT: AFCEE

COMPANY: Parsons Engineering Science

LOCATION: UST Site -- Beale AFB, CA

PROJECT: 722450.14

# MW-2 (Rising Head Test #1)




DATA SET:
AM21R.DAT
10/31/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Bouwer-Rice

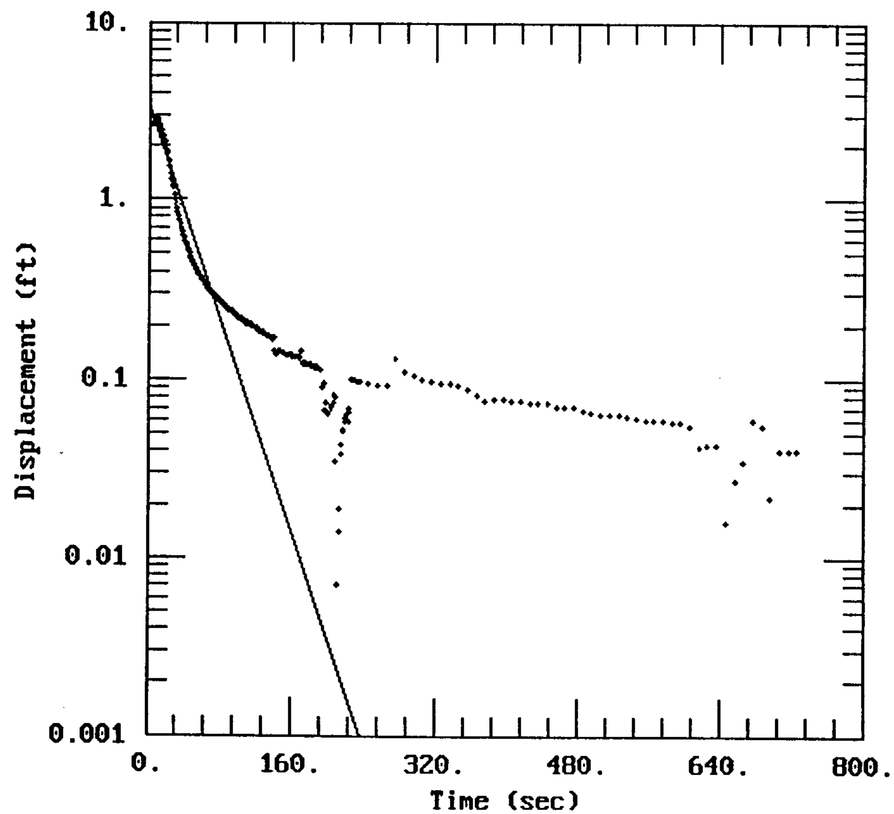
TEST DATA:
H0= 5.557 ft
$r_c$= 0.083 ft
$r_w$= 0.344 ft
L = 3. ft
b = 3. ft
H = 3. ft

PARAMETER ESTIMATES:
K = 5.789E-05 ft/sec
y0 = 5.145 ft

AQTESOLV

| CLIENT: AFCEE | COMPANY: Parsons Engineering Science |
|---|---|
| LOCATION: UST Site -- Beale AFB, CA | PROJECT: 722450.14 |

# MW-2 (Falling Head Test #2)




DATA SET:
AM22F.DAT
10/31/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 2.901 ft
$r_c$= 0.083 ft
$r_w$= 0.344 ft
L = 3. ft
b = 3. ft
H = 3. ft

PARAMETER ESTIMATES:
K = 6.113E-05 ft/sec
y0 = 3.262 ft

AQTESOLV

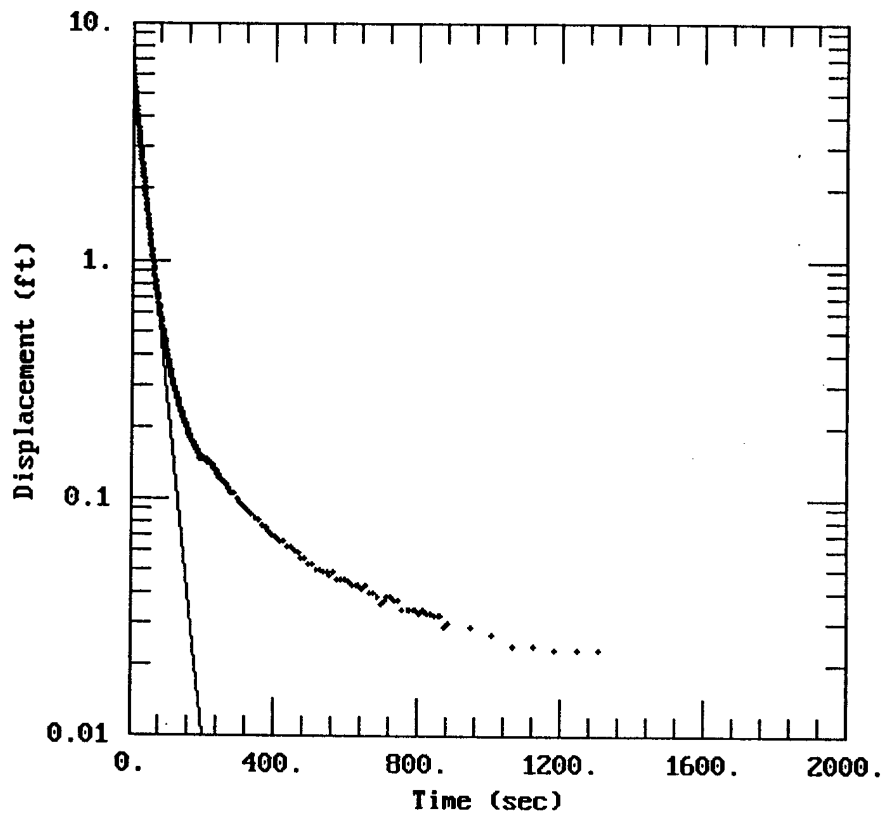
CLIENT: AFCEE

COMPANY: Parsons Engineering Science

LOCATION: UST Site -- Beale AFB, CA

PROJECT: 722450.14

# MW-2 (Rising Head Test #2)




DATA SET:
AM22R.DAT
10/31/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 6.98 ft
$r_c$= 0.083 ft
$r_w$= 0.344 ft
L = 3. ft
b = 3. ft
H = 3. ft

PARAMETER ESTIMATES:
K = 5.708E-05 ft/sec
y0 = 6.393 ft

AQTESOLV

# APPENDIX E

# MODEL INPUT AND OUTPUT FILES AND HYDRAULIC TESTING FILES

# APPENDIX F

# REMEDIAL ALTERNATIVE COST CALCULATIONS

**Intrinsic Remediation Treatability Study**
**UST Sites - Beale AFB, California**

## Present Worth Analysis

Annual Adjustment Factor = 7%

| Intrinsic Remediation with Institutional Controls and Long-Term Groundwater and Surface Water Monitoring | | Present Worth | Cost (in current $) at Year Indicated (all years not shown) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | years | ($) | 1 | 2 | 3 | 4 | 5 | 10 | 15 |
| Maintain Institutional Controls | 15 | $45,540 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 |
| Long-term Monitoring | | | | | | | | | |
| Install New Wells | 1 | $5,530 | $5,917 | $0 | $0 | $0 | $0 | $0 | $0 |
| Groundwater/Surface Water Sampling | 15 | $42,928 | $13,367 | $3,342 | $3,342 | $3,342 | $3,342 | $3,342 | $3,342 |
| Reporting/Project Mgmt | 15 | $9,883 | $1,085 | $1,085 | $1,085 | $1,085 | $1,085 | $1,085 | $1,085 |
| Subtotal Present Worth ($) | | $103,880 | | | | | | | |

Total Present Worth Cost ($): $103,880

**Long-Term Monitoring and Institutional Controls**

Standard Rate Schedule

| ling Category Cost Code/(Billing Category) | Billing Rate | Task 1 (hrs) | Install New LTM Wells ($) | Task 2 (hrs) | Sampling (per event) ($) | Task 3 (hrs) | Reporting/PM (per event) ($) |
|---|---|---|---|---|---|---|---|
| Word Processor 88/(15) | $30 | 0 | $0 | 0 | $0 | 3 | $90 |
| CADD Operator 58/(25) | $47 | 2 | $94 | 0 | $0 | 0 | $0 |
| Technician 42/(50) | $40 | 4 | $160 | 24 | $960 | 5 | $200 |
| Staff Level 16/(65) | $57 | 16 | $912 | 8 | $456 | 8 | $456 |
| Project Level 12/(70) | $65 | 6 | $390 | 2 | $130 | 4 | $260 |
| Senior Level 10/(80) | $85 | 0 | $0 | 0 | $0 | 0.25 | $21 |
| Principal 02/(85) | $97 | 0 | $0 | 0 | $0 | 0 | $0 |
| Total Labor (hrs\|$) | | 28 | $1,556 | 34 | $1,546 | 20.25 | $1,027 |
| ODCs | | | | | | | |
| Phone | | | $14 | | $15 | | $7 |
| Photocopy | | | $2 | | $1 | | $2 |
| Mail | | | $8 | | $100 | | $8 |
| Computer | | | $19 | | $19 | | $30 |
| CAD | | | $30 | | $0 | | $0 |
| WP | | | $0 | | $0 | | $11 |
| Travel | | | $99 | | $99 | | $0 |
| Per Diem | | | $200 | | $200 | | $0 |
| Eqpt. & Supplies | | | $50 | | $102 | | $0 |
| Total ODCs | | | $421 | | $536 | | $58 |
| side Services | | | | | | | |
| TM/POC Well Installation Costs [a/] | | | $3,700 | | $0 | | $0 |
| Laboratory Fees [b/] | | Soils | $240 | 3 MWs, 3 SWs, | $1,260 | | $0 |
| Other: Maintain Institutional Controls | | | $0 | and 2 qa/qc, | | | $5,000 |
| Total Outside Services | | | $3,940 | | $1,260 | | $5,000 |

| Proposal Estimate | Task 1 | Task 2 | Task 3 |
|---|---|---|---|
| Labor | $1,556 | $1,546 | $1,027 |
| ODC's | $421 | $536 | $58 |
| Outside Services | $3,940 | $1,260 | $5,000 |
| Total by Task | $5,917 | $3,342 | $6,085 |

Task 1: Install New LTM/POC Wells
Task 2: Sampling per Event
Task 3: Reporting and PM per Sampling Event

[a/] 2 Wells, 15ft @ $70/ft, $2000mob, $100 soil handling
[b/] BTEX/TPH @ $60ea, Electron acceptors at LTM wells @ $75ea

## Beale AFB Backup Calculations

**Long-term Monitoring**

| **Misc calculations** | | | **Cost calculations** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Description | Unit | Qty. | Unit Price | Subtotal | Total | Source (If applicable) |
| Number of LTM wells: | | | Well Installation | | | | | $ 3,700 | |
| Number of wells: | 2 | | Mobilization | ea | 1 | $ 2,000 | $ 2,000 | | |
| Depth each: | 15 | ft | Well Installation | ln ft | 30 | $ 50 | $ 1,500 | | |
| | | | Soil Disposal | drum | 2 | $ 100 | $ 200 | | |

# APPENDIX F

# REMEDIAL ALTERNATIVE COST CALCULATIONS

**Intrinsic Remediation Treatability Study**
**UST Sites - Beale AFB, California**

## Present Worth Analysis

Annual Adjustment Factor = 7%

| Intrinsic Remediation with Institutional Controls and Long-Term Groundwater and Surface Water Monitoring | years | Present Worth ($) | Cost (in current $) at Year Indicated (all years not shown) 1 | 2 | 3 | 4 | 5 | 10 | 15 |
|---|---|---|---|---|---|---|---|---|---|
| Maintain Institutional Controls | 15 | $45,540 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 |
| Long-term Monitoring | | | | | | | | | |
| Install New Wells | 1 | $5,530 | $5,917 | $0 | $0 | $0 | $0 | $0 | $0 |
| Groundwater/Surface Water Sampling | 15 | $42,928 | $13,367 | $3,342 | $3,342 | $3,342 | $3,342 | $3,342 | $3,342 |
| Reporting/Project Mgmt | 15 | $9,883 | $1,085 | $1,085 | $1,085 | $1,085 | $1,085 | $1,085 | $1,085 |
| Subtotal Present Worth ($) | | $103,880 | | | | | | | |

Total Present Worth Cost ($): $103,880

**Long-Term Monitoring and Institutional Controls**

Standard Rate Schedule

| Billing Category<br>Cost Code/(Billing Category) | Billing Rate | Task 1 (hrs) | Install New LTM Wells ($) | Task 2 (hrs) | Sampling (per event) ($) | Task 3 (hrs) | Reporting/PM (per event) ($) |
|---|---|---|---|---|---|---|---|
| Word Processor 88/(15) | $30 | 0 | $0 | 0 | $0 | 3 | $90 |
| CADD Operator 58/(25) | $47 | 2 | $94 | 0 | $0 | 0 | $0 |
| Technician 42/(50) | $40 | 4 | $160 | 24 | $960 | 5 | $200 |
| Staff Level 16/(65) | $57 | 16 | $912 | 8 | $456 | 8 | $456 |
| Project Level 12/(70) | $65 | 6 | $390 | 2 | $130 | 4 | $260 |
| Senior Level 10/(80) | $85 | 0 | $0 | 0 | $0 | 0.25 | $21 |
| Principal 02/(85) | $97 | 0 | $0 | 0 | $0 | 0 | $0 |
| Total Labor (hrs\|$) | | 28 | $1,556 | 34 | $1,546 | 20.25 | $1,027 |
| ODCs | | | | | | | |
| Phone | | | $14 | | $15 | | $7 |
| Photocopy | | | $2 | | $1 | | $2 |
| Mail | | | $8 | | $100 | | $8 |
| Computer | | | $19 | | $19 | | $30 |
| CAD | | | $30 | | $0 | | $0 |
| WP | | | $0 | | $0 | | $11 |
| Travel | | | $99 | | $99 | | $0 |
| Per Diem | | | $200 | | $200 | | $0 |
| Eqpt. & Supplies | | | $50 | | $102 | | $0 |
| Total ODCs | | | $421 | | $536 | | $58 |
| Outside Services | | | | | | | |
| LTM/POC Well Installation Costs [a/] | | | $3,700 | | $0 | | $0 |
| Laboratory Fees [b/] | | Soils | $240 | 3 MWs, 3 SWs, | $1,260 | | $0 |
| Other: Maintain Institutional Controls | | | $0 | and 2 qa/qc, | | | $5,000 |
| Total Outside Services | | | $3,940 | | $1,260 | | $5,000 |

| Proposal Estimate | Task 1 | Task 2 | Task 3 |
|---|---|---|---|
| Labor | $1,556 | $1,546 | $1,027 |
| ODC's | $421 | $536 | $58 |
| Outside Services | $3,940 | $1,260 | $5,000 |
| Total by Task | $5,917 | $3,342 | $6,085 |

Task 1: Install New LTM/POC Wells

Task 2: Sampling per Event

Task 3: Reporting and PM per Sampling Event

[a/] 2 Wells, 15ft @ $70/ft, $2000mob, $100 soil handling

[b/] BTEX/TPH @ $60ea, Electron acceptors at LTM wells @ $75ea

## Beale AFB Backup Calculations

**Long-term Monitoring**

| **Misc calculations** | | | **Cost calculations** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Description | Unit | Qty. | Unit Price | Subtotal | Total | Source (If applicable) |
| Number of LTM wells: | | | Well Installation | | | | | $ 3,700 | |
| Number of wells: | 2 | | Mobilization | ea | 1 | $ 2,000 | $ 2,000 | | |
| Depth each: | 15 | ft | Well Installation | ln ft | 30 | $ 50 | $ 1,500 | | |
| | | | Soil Disposal | drum | 2 | $ 100 | $ 200 | | |